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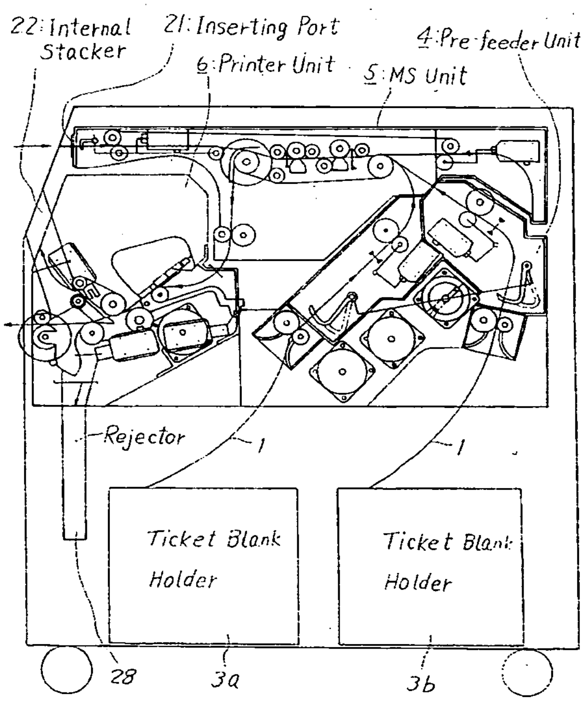
(54) Ticket and ticket printer.

(57) A ticket on which ticketing data can be both magnetically recorded and printed includes a base 13, a heat-sensitive layer 14 provided on one side of the base, a protective layer 15 provided on the heat-sensitive layer and a magnetic recording layer 11 provided on the other side of the base. The corresponding ticket printer for magnetically recording and printing ticketing data on ticket blanks includes ticket blank holder means 3a,3b, magnetic recording means 5 for magnetically recording ticketing data on the magnetic recording layers of the ticket blanks, and thermal printing means 6 for thermally printing the ticketing data on the heat-sensitive layer of the magnetically recorded ticket blanks for issuance. For security, continuous blanks 1 are used, separated by perforations, and the printer includes a pre-feeder unit 4 for separating individual blanks.

FIG. 6.



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The present invention relates generally to a ticket and a corresponding ticket printer and, more particularly, to a valuable ticket in which ticketing data is both magnetically recorded and printed and to a ticket printer for issuing such a ticket by recording and printing ticketing data on it.

In airline and other industries, a reservation and ticketing system for airline or other tickets, called a computer reservation system or CRS for short, has been built up so as to deal with intensive passenger-conscious services. A problem of vital importance for such a system designed to accommodate a recently increasing number of passengers is to make its services (for reservation and fare adjustment) efficient.

For that reason, the use of airline tickets provided with magnetic strips or stripes so as to control these services in bulk, called automated ticket/boarding pass or ATB for short, is now spreading. These tickets are required have a high storage stability of printed data and to have the ability to be printed easily as well. A ticket printer for them for its part is required to make ticket management easy and to render ticketing less time- and labor-consuming as well.

2. Description of the Related Art

Tickets issued from a conventional ticket printer have made use of plain paper and been printed on wire-dot, electrophotographic and other printing systems. The wire-dot printing system involves some grave problems such as (1) loud noise, (2) low print resolution and (3) slow printing speed, and the electrophotographic printing system has again some serious problems such as (1) an increase in hardware size, (2) a rise in hardware cost and (3) susceptibility to environmental changes (printing is difficult at high humidity in particular). In recent years, hardware working on a thermal-dot printing system making use of a heat transfer ink ribbon has been developed.

This thermal-dot printing system making use of a heat transfer ink ribbon makes no noise, has a high print resolution and a high printing speed, achieves reductions in hardware size and cost and dispenses with any maintenance, and so lends itself well to issuing airline tickets.

However, some serious problems with the conventional thermal-dot printing system making use of a heat transfer ink ribbon are that (1) the heat transfer ink ribbon costs much and incurs some considerable expense for maintenance, and (2) the heat transfer ink ribbon is troublesome to handle, because it must be replaced by new one whenever a certain number of prints are obtained.

Consequently, it is now desired to use printing hardware working on a direct thermal printing system - in which case heat-sensitive paper is directly printed - and making no use of any heat transfer ink ribbon. In the case of airline tickets that are a sort of securities, however, there are the following problems.

(1) Generally, the thermal-printing paper is a paper that is obtained by coating a heat-sensitive layer comprising a leucodye, a color developer and a binder onto a paper substrate at a thickness of a few μm. When heated by a thermal printing element, the leucodye and color developer are fused to give rise to a color-developing chemical reaction. However, this color-developing zone, when stored over an extended period, disappears, thus rendering the thermally printed paper valueless.

(2) A printed thermal-printing paper, when coming into contact with an organic solvent such as alcohol, a plasticizer and oils and fats, breaks up the chemical reaction, causing the color-developing zone to disappear.

Conventional airline ticket printers have been broken down into two types, one in which a stock of precut ticket blanks are fed out one by one for magnetic recording and printing, and the other in which a stock of continuous paper blank is magnetically recorded and printed.

The former airline ticket printer has an advantage in that the precut ticket blanks can be easily magnetically recorded and printed. These tickets are a sort of high-priced securities, and so there is a need of managing the blanks therefor. However, not only is it difficult to manage such separate ticket blanks, but they are also likely to be missing by wrongdoing or in error. In addition, much difficulty is encountered in finding them, when missing.

The latter airline ticket printer has an advantage in that the continuous ticket blank can conveniently be managed, because whether or not something wrong is occurring can be easily determined by finding the presence of cutouts. However, it is difficult to make magnetic records and prints on a continuous form of ticket blank, and this form of ticket blank costs much time and labor, because it is required for an operator to separate it into individual tickets and hand them to passengers.

An object of the invention is to provide a form of ticket which, even when printed using a direct thermal printing system, does not lose the printed information. Another object of the invention is to provide a ticket printer for issuing such a ticket.

Some embodiments of the invention in particular provide a ticket printer which enables ticket blanks to be easily managed and is capable of issuing a valuable form of tickets individually. Ticket printers according to other embodiments of the invention may be so compact in size that they can be located between desks.

A ticket according to the invention enables ticketing data to be magnetically recorded and printed, and includes a base, a heat-sensitive layer applied on one side of the base, a protective layer applied on the

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heat-sensitive layer and a magnetic recording layer applied on the other side of the base.

Because the protective layer is applied to the heat-sensitive layer, tickets in accordance with the invention can be proof against contact with solvents, plasticizers, and so on. Besides, the ticket of the invention can be used in the form of a security, because the color-developing zone will not be erased, even when formed by a simple direct thermal printing system, and so is high in terms of storage stability.

Because the magnetic recording layer is applied on the opposite side of the base to the side on which the heat-sensitive layer is formed and so the heat-sensitive layer is available over the full side to be printed, it is possible to make effective use of a ticket having a small area. With tickets in accordance with the invention the magnetic recording layer is not affected by the heat of a thermal recording element, so that data magnetically recorded there is invariable; it is therefore possible to make sufficient prints and record the magnetic data reliably.

A ticket printer according to the invention comprises a stock holder unit for holding ticket blanks, each including a heat-sensitive layer and a protective layer on one side of a base and a magnetic recording layer on the other side of the base, a thermal printer unit for thermally printing the heat-sensitive layer of each ticket blank fed out of the stock holder unit and a magnetic recorder unit for magnetically recording data on the magnetic recording layer of the ticket blank.

According to this ticket printer, it is possible to issue valuable tickets of high storage stability, because they can be protected against coming into contact with solvents, plasticizers, etc., due to the provision of the protective layer on the heat-sensitive layer, and because their color-developing zones are by no means erased, even when formed by the thermal printer unit that makes use of a simple direct thermal recording system.

Another ticket printer of the invention is designed to print and magnetically record ticketing data on a ticket blank and thereby issue a valuable ticket, and comprises a ticket blank holder for containing a continuous form of medium that is separated along perforations into individual ticket blanks, a pre-feeder unit for feeding the continuous form of medium from the ticket blank holder and cutting and separating the medium into individual ticket blanks, a magnetic recorder unit for magnetically recording ticketing data on a magnetic recording layer of each ticket blank cut by and fed from the pre-feeder unit, and a printer unit for printing ticketing information on the magnetically recorded ticket blank.

This ticket printer makes magnetic recording and printing easy and dispenses with separating tickets after issuance, because, even when a continuous form of medium is used, it is cut through the pre-feeder unit to individual ticket blanks and these individual ticket blanks are magnetically recorded and printed, and so the valuable ticket blanks can be easily controlled as a continuous form of medium and, besides, can be magnetically recorded and printed individually.

Other features and advantages of the present invention will be apparent from the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a sectional view of one example of the airline ticket according to the invention,
Figure 2 is an upper view of the airline ticket of Fig. 1,
Figure 3 is a characteristic graph that shows the storage stability of the airline ticket of Fig. 1,
Figure 4 is an illustration of the appearance of one embodiment of the airline ticket printer according to the invention,
Figure 5 is a perspective view of the airline ticket printer of Fig. 4 in which all the units are drawn out,
Figure 6 is a sectional view of the airline ticket printer of Fig. 4,
Figure 7 is a sectional view of the pre-feeder unit of the airline ticket printer of Fig. 6,
Figure 8 is an exploded perspective view of the pre-feeder unit of Fig. 7,
Figure 9 is a perspective view of the pre-feeder unit of Fig. 8 that is in a finished-up state,
Figure 10 is an illustration showing part of the pre-feeder unit of Fig. 7,
Figure 11 is a performance time chart of the pre-feeder unit of Fig. 7,
Figure 12 is a first illustration of how the pre-feeder unit of Fig. 7 works,
Figure 13 is a second illustration of how the pre-feeder unit of Fig. 7 works,
Figure 14 is a sectional view of the MS unit of the airline ticket printer of Fig. 6,
Figure 15 is a perspective view of the MS unit of Fig. 14,
Figure 16 is a view illustrating part of the MS unit of Fig. 14,
Figure 17 is a sectional view of the printer unit of the airline ticket printer of Fig. 6,
Figure 18 is a front view showing part of the printer unit of Fig. 17,
Figure 19 is a view illustrating part of the printer unit of Fig. 17,
Figure 20 is a representation that illustrates the attachment or detachment of the head in the printer unit of Fig. 17,
Figure 21 is a view that shows the construction of another embodiment of the pre-feeder unit,
Figure 22 is an illustration of how the pre-feeder

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unit of Fig. 21 works,

Figure 23 is a view that illustrates the construction of a further embodiment of the pre-feeder unit,

Figure 24 is an illustration of how the pre-feeder unit of Fig. 23 works,

Figure 25 is an illustration of where the MS unit of Fig. 16 starts to write,

Figure 26 is a block diagram that provides an illustration of how the write start position of the MS unit of Fig. 16 is corrected,

Figure 27 is a block diagram that illustrates the function of a main controller unit shown in Fig. 26,

Figure 28 is a flow chart for correcting the write start position of the MS unit of Fig. 16, and

Figure 29 is an illustration of how the block of Fig. 27 works.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to Figs. 1-3, there is shown an airline ticket that is one embodiment of the invention.

As illustrated in Fig. 1(A), an airline ticket blank, shown generally by 1a, comprises a paper base 13 that is provided on its one (back) side with a heat-sensitive layer 14 having on its surface a protective layer 15 formed of water-soluble resin. On the opposite (front) side of the paper base 13 there is provided a magnetic stripe 11. This heat-sensitive layer 14 is composed of an irreversible pigment, a developer and a binder.

Thus, the provision of the protective layer 15 on the surface of the heat-sensitive layer 14 can physically prevent a solvent such as alcohol, a plasticizer, and so on from entering the heat-sensitive layer 14. This in turn makes it possible to prevent a solvent such as alcohol, a plasticizer, and so on from coming into contact with the portion of the heat-sensitive layer 14 that develops color by chemical reactions, thereby breaking up such chemical reactions and so resulting in fade-out.

The irreversible pigment is used as the color-developing dye in the heat-sensitive layer 14, so that the ticket according to this embodiment can stand up to long-term storage and so is best suited as a reservation ticket.

The magnetic stripe 11 is provided on the side of the paper base 13 that is opposite to the side on which the heat-sensitive layer 14 is provided, so that the heat-sensitive layer 14 is available all over the surface for printing, thus assuring adequate printing. In addition, the magnetic stripe 11 is unlikely to receive printing heat directly and so the magnetically recorded data thereon are unlikely to change.

Another embodiment of the ticket shown in Fig. 1(B) follows the construction shown in Fig. 1(A) with the exception that an additional protective layer 16 is provided on the side of the paper base 13 with the magnetic stripe 11 formed on it. According to this embodiment, it is possible to prevent solvents, plasticizers, etc., from penetrating into the heat-sensitive layer 14 through the paper base 13, and so it is possible to improve the storage stability of the ticket further.

As illustrated in Fig. 2, this airliner ticket blank 1a is in the form of continuous paper 1 that is provided with folds 19 perforated, as shown at 17, for its easy separation with suitable equipment. Further, each perforation 17 is cut in from both edges, as shown at 18, for easier separation of each ticket blank. It is here noted that one ticket blank 1a is divided by a fold 19 from another, and provided with additional two perforations 17', so that a ticket collector can receive the stub when it is used.

As can be seen from Fig. 3 that is a storage stability diagram, a conventional heat-sensitive ticket having no protective layer 15 decreases in terms of the residual rate of the color-developing zone to 50% with respect to a solvent, 30% with respect to oils and fats and 10% with respect to a plasticizer, but the heat-sensitive ticket of the invention, shown in Fig. 1(A), is of good-enough storage stability, because the residual rate of the color-developing zone is nearly invariable, i.e., 100% with respect to a solvent, 100% with respect to oils and fats and 90% with respect to a plasticizer.

The airliner ticket printer according to the invention will now be explained with reference to Figs. 4, 5 and 6.

Referring first to Fig. 4, there is perspectively shown an airliner ticket printer shown generally at 2. This ticket printer is built up of a housing 20, an inlet port 21 through which an unrecorded, unprinted ticket blank is inserted for printing and magnetic recording, an internal stacker or hopper 22 for storing printed, magnetically recorded ticket blanks, and an ejection port 23 for ejecting the printed, magnetically recorded ticket blanks. Reference numeral 24 represents a display (e.g., a liquid-crystal display - LCD) for guidance and other purposes, 25 an indicator (e.g., a light-emitting diode - LED) for providing an indication of what state the ticket printer is in, and so on, and 26 a control panel that is covered and includes keys for various operations.

Referring then to Figs. 5 and 6, the printer 2 includes in its lower portion ticket blank stock holders 3a and 3b in which the continuous paper 1 shown in Fig. 2 is set in order and kept in stock. The printer 2 further includes a pre-feeder unit 4 in which the continuous paper 1 fed from the ticket blank stock holders 3a and 3b is cut and separated into individual tickets blanks 1a and the ticket blanks are put in order in the widthwise direction and then in a ready-for-further-feeding state, an MS (magnetic recording) unit 5 for magnetically recording on the magnetic stripe 11 of each separated ticket blank 1a ticketing data (for in-

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stance, destination, departure and arrival dates and times, flight number, seat number, and so on), and a printer unit 6 for thermally printing on the side 12, to be printed, of the magnetically recorded ticket blank 1a, ticketing data (for instance, destination, departure and arrival dates and times, flight number, seat number, and so on) for issuance.

Also built in the printer 2 are slide rails 27a and 27b for pulling out of the housing 20 the ticket blank stock holders 3a and 3b, pre-feeder unit 4, MS unit 5, printer unit 6, and so on, and a reject unit 28 for keeping some defective tickets 1a, if any, in stock.

In the instant embodiment, individual ticket blanks 1a are stocked in the form of the continuous paper 1. This is because the respective ticket blanks 1a must have been serially numbered owing to being the originals of securities. The tickets being in the form of continuous paper means that pilferage is by no means feasible, unless the paper is cut; in other words, as long as the tickets are in a continuous form, it can be judged that something wrong such as pilferage has not occurred. In the case where ticket blanks are stocked in a separate state, some considerable time and labor are needed for determining whether or not pilferage has occurred, thus making their control difficult. However, if they are in a continuous form, they can then be easily controlled as securities.

On the other hand, some difficulty is involved in feeding continuous paper directly for magnetic recording, and the continuous paper, if ejected, must be cut manually. For these reasons, the printer is designed such that the continuous paper 1 is cut and separated into individual ticket blanks through the pre-feeder unit 4, and they are then magnetically recorded through the MS unit 5 and finally printed through the printer unit 6 for issuance.

In addition, the pre-feeder unit 4 is designed such that each ticket blank 1a previously cut and separated there is put in a ready-for-further-feeding state and, by an issuance order, is fed to the MS unit 5, thereby improving the issuance speed.

Furthermore, the printer unit 6 works on a direct printing mode making use of a thermal head, so that printing can be made easily and in a timesaving and laborsaving manner as well.

The ticket printer according to this embodiment is reduced in height and in depth as well by locating the ticket stock holders 3a and 3b in its lower region and locating the pre-feeder, MS and printer units 4, 5 and 6 above them. In particular, the ticket printer is made further compact by disposing the pre-feeder unit 4 diagonally to extend the ticket blank feed passage from the lower portion to the back side thereof and then from the back side to the front side thereof.

In order to print and magnetically record data on a manually inserted ticket blank, the ticket blank is inserted into the MS unit 5 through the inlet port 21 for magnetic recording and then printed through the printer unit 6 for issuance. The provision of the internal stacker 22 enables a large quantity of tickets for party travelers, for instance, to be stacked up and issued.

Each part of such an airliner ticket printer will now be explained at great length. Reference will first be made to Figs. 7, 8, 9 and 10.

As can be seen from Fig. 7, there are provided ticket suction ports 40a and 40b through which the continuous paper 1 is sucked from the ticket blank stock holders 3a and 3b, feed rollers 41a and 41b for paper feeding and pinch rollers 41c and 41d for feeding the paper while it is held between them and the feed rollers 41a and 41b. Also, there are provided ejection rollers 42a and 42b for paper feeding and pinch rollers 44a and 44b for feeding the paper while it is held between them and the rollers 42a and 42b. Additionally, there are provided pulse motors PM1 and PM2 for driving the rollers 41a, 42a and 41b, 42b and timing belts 43a and 43b for rotating the rollers 41a, 42a and 41b, 42b by the rotational forces of the pulse motors PM1 and PM2.

Magnets MG1 and MG2 are provided for engaging or disengaging the pinch rollers 44a and 44b with or from the rollers 42a and 42b, and sensors S1 and S2 are located for detecting that a cut medium passes by and is present or absent. Reference numeral 45 represents a cam for driving a link 46 linearly, PM3 a pulse motor for rotating the cam 45, 46 a link designed to move linearly by the rotation of the cam 45, and 47a and 47b burst cutters that are driven by the link 46 for burst-cutting the perforation 17 in the continuous paper 1. S3 represents a sensor for sensing the location of the link 46, thereby detecting that the cutters 47a and 47b are at their positions available for cutting, and S4 denotes another sensor for sensing the location of the link 46, thereby detecting that the cutters 47a and 47b are at their retracted positions.

As can be seen from Figs. 8 and 9, the feed rollers 41a and 42a are attached to a unit frame 48 of the pre-feeder unit 4. This feed roller 41a is provided with a gear 410 that meshes with the timing belt 43a driven by a driving gear 411 of the pulse motor PM1. Similarly, the feed roller 42a is provided with a gear 420 that meshes with the timing belt 43a, a gear 421 integral with the gear 420, a gear 422 and auxiliary gears 423, 424.

As illustrated in Fig. 10(A), the gears 420 and 421 of the feed roller 42a are provided therethrough with a one-way clutch 421a that works only in the direction shown at B in this figure, and the gear 422 is provided therethrough with a one-way clutch 422a as well, which works only in the direction shown at B in this figure. Then, the auxiliary gear 423 meshes with the gear 421, the auxiliary gear 424 meshes with the auxiliary gear 423, and the gear 422 meshes with the auxiliary gear 424.

As can be seen from Fig. 10(A), as the timing belt 43a is driven in the direction B, the rotations of the

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gears 420 and 421 are transmitted to the shaft of the feed roller 42a by way of the one-way clutch 421a, so that the feed roller 42a can rotate in the direction B or forwardly. At this time, the gear 422 is rotated in the direction A or backwardly by the gear 421 through the auxiliary gears 423 and 424, but it remains idle by the operation of the one-way clutch 422a.

As the timing belt 43a is driven in the direction A in Fig. 10(A), the gears 420 and 421 rotate, but they remain idle by the operation of the one-way clutch 421a. This in turn causes the gear 422 to rotate by the gear 421 by way of the auxiliary gears 423 and 424 in the direction B or forwardly in this figure, so that its rotation can be transmitted to the shaft of the feed roller 42a by the one-way clutch 422a, thereby rotating the feed roller 42a in the direction B or forwardly in this figure.

Thus, the feed roller 42a can be rotated in the direction B or forwardly, irrespective of whether the timing belt 43a is fed in the direction A (forwardly) or B (backwardly), enabling the medium to be fed forwardly.

As illustrated in Fig. 10(B), a right-hand frame 48' is provided with a biasing spring 49 that serves to engage each cut ticket blank 1a with a left-hand frame 48, so that it can be put in order in the widthwise direction.

While the arrangement shown in Figs. 8-10 has been described chiefly with reference to the suction port 40a that corresponds to the ticket blank holder 3a shown in Fig. 7, it is understood that this is true of the suction port 40b that corresponds to the ticket blank holder 3b.

How the pre-feeder unit 4 works will now be explained with reference to Figs. 11, 12 and 13.

In their initial state shown in Fig. 12(A), the cutters 47a and 47b are at their ready-to-cut positions, and so block up the feed passage. In this state, the operator operates an associated lever, not shown, to retract the pinch roller 41c, and then inserts the continuous paper 1 into the suction port 40a until it abuts against the back of the cutter 47a. Thereafter, the operator operates the lever to close up the pinch roller 41c, and then inserts the leading end of the continuous paper 1 between the feed roller 41a and the pinch roller 41c for setting the continuous medium in place.

Then, the magnet MG1 is first driven to close up the retracted pinch roller 44a so as to retract the cutter 47a, as shown in Fig. 12(B). Subsequently, the pulse motor PM 3 for the cutter is rotated counterclockwise (or in the CCW direction) to move the link 46 by the cam 45 in the right-handed direction in this figure, thereby retracting the cutter 47a. The rotation of this pulse motor PM 3 is put off when the output of the sensor S4 is low, indicating that the cutter has reached its retracted position, as shown in Fig. 11.

With the pulse motor PM1 for paper feed rotated counterclockwise (or in the forward direction), the feed rollers 41 and 42a are then rotated in the forward direction by the timing belt 43a for paper feed. The pulse motor PM1 stops upon the perforation 17 of the medium 1 reaching the location of the cutter 47a. This is because the output of the sensor S1 decreases upon detecting that the leading end of the medium 1 passes by. In this state, the perforation 17 in the medium (continuous paper) 1 is positioned at the location of the cutter 47a.

Then, the PM1 for paper feeding is rotated 2 to 5 steps clockwise (or in the CW direction), as shown in Fig. 13(A). This in turn causes a reversal of the feed roller 41a and a forward rotation of the feed roller 42a by the operations of the above-mentioned one-way clutches 421 and 422a shown in Fig. 10, thereby pulling the medium 1 by both the feed rollers 41a and 42a to impart tension to the medium 1, thereby making it easy to cut the medium 1.

With no tension imparted to the medium 1, the continuous medium 1 may become loose at the location of the cutter due to a difference in the feed speed between the feed rollers 41a and 42a that is caused by a difference in their outer diameters, making the proper cutting of the medium 1 unlikely. In the instant embodiment, however, tension can be applied by the feed rollers 41a and 42a to the medium; in other words, the feed mechanism itself has the ability to impart tension to the medium, and so can be simplified in structure.

As shown in Fig. 13(B), the pulse motor PM 3 for the cutter is further rotated counterclockwise to move the link 46 by the cam 45 in the left-handed direction in this figure, so that the cutter 47a can beat the perforation 17 of the medium 1 for burst-cutting.

The medium 1 can then be cut easily and surely, because tension is imparted to the medium 1, as shown in Fig. 13(A), and because the perforation 17 in the medium 1 is cut on both its sides, as shown at 18.

After the cutting of the medium is completed, the pulse motor PM 1 is rotated 40 steps clockwise (or in the CW direction), as shown Fig. 11. This in turn causes a reversal of the feed roller 41a and a forward rotation of the feed roller 42a by the operations of the above-mentioned one-way clutches 421a and 422a shown in Fig. 10, thus separating the cut medium 1a from the continuous medium 1 and putting it in a ready-for-further-feeding state on the ejection port side.

After that, as the magnet MG1 is put off, as shown in Fig. 11, the pinch roller 44a is retracted to enable each cut medium 1a to be widthwise engaged with the left-hand frame 48 by the biasing spring 49 attached to the right-handed side frame 48', shown in Fig. 10(B). In this manner, the pre-feeding of each ticket blank is completed.

Upon receipt of an issuance command, the sequences from Fig. 12(B) occur, and the cut medium

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1a that is standing ready for further feeding is fed to the magnetic recording unit 5, while the continuous medium 1 is fed and cut and then allowed to stand ready for further feeding.

Because the set continuous paper 1 is precut into individual ticket blanks 1a ready for further feeding, each ticket blank 1a can be fed to the magnetic recorder unit 5 just upon receipt of issuance instructions, thereby improving issuance speed.

While the operations of the parts located on the suction port (40a) side corresponding to the ticket blank holder 3a have been described with reference to Figs. 12 and 13, it is understood that those on the suction port (40b) side corresponding to the ticket blank holder 3b operate similarly. In this case, the cutter-driving PM 3, cam 45 and link 46 are commonly used.

The magnetic recording unit 5 will now be explained with reference to Figs. 14, 15 and 16.

As shown in Fig. 14, the MS (magnetic recording) unit 5 includes a manually-inserting portion 5b for receiving a manually inserted ticket blank, an MS read-write unit 5a for magnetically recording data on the magnetic stripe 11 of the ticket blank and a portion 5c in which the manually inserted ticket blank stands ready for further feeding. As shown in Figs. 14 and 15, an upper feed belt 52 is provided all over the hand-inserting portion 5c, the MS read-write portion 5a and the portion 5c.

The MS read-write unit 5a is provided with a lower feed belt 53 for feeding the ticket blank 1a while it is held between the upper and lower feed belts 52 and 53, a write head 50 for magnetically recording data on the magnetic stripe 11 of the ticket blank 1a and a read head 51 for read-after-write check.

Further, there are provided a guide roller 50a opposite to the write head 50, a guide roller 51a opposite to the read head 51, a gate 54 for guiding the magnetically recorded ticket 1a to the printer unit 6 or the hand-inserting portion 5b, and a discharge roller 55 for ejecting the ticket 1a into the printer unit 6.

The manually-inserting portion 5b includes a shutter 56 located on an inserting port 21 and a magnet MG3 that opens the shutter 56 in association with hand insertion, thereby switching the gate 54 over to the hand-inserting portion 4b.

The standby portion 5c includes a roller 57 opposite to the upper feed belt 52 and a magnet MG4 for moving and engaging the roller 57 toward and with the upper feed belt 52.

As shown in Fig. 16, the MS read-write unit 5a includes a biasing spring 58 attached to a right-hand frame 59', which serves to bias the ticket blank 1a a left-hand frame (guide) 59 at the write and read heads 50 and 51.

Explaining this operation, the ticket blank 1a fed from the pre-feeder unit 4 is supplied, whil it is sandwiched between the upper and lower feed belts 52 and 53, to the write head 50 where data are magnetically recorded on the magnetic stripe 11 of the ticket blank 1a. Then, it is further fed to the read head 51 where the data are read, and ejected into the printer unit through the ejection roller 55 by way of the gate 54.

In this case, it is assured that the data can be written onto the magnetic stripe by the write head 50 and read therefrom by the read head 51, because the ticket blank 51a is carried while it is biased by the biasing spring 58 against the left-hand guide 59 on the side of which there are the heads 50 and 51. Also, since the ticket blank is fed by the feed belts 52 and 53 without undergoing any speed change, it is assured that the data can be written onto the magnetic stripe 11 by the head 50 and read therefrom by the head 51.

In the case of the manually inserted ticket blank, on the other hand, the shutter 56 is opened by the magnet MG3 and the gate 54 is actuated to connect the hand-inserting portion 5b with the MS read-write portion 5a. Then, the ticket blank 1a is fed by the upper feed belt 52 through the inserting port 21 and the read-write portion 5a to the standby portion 5c where it stands ready for further feeding.

Upon receiving an issuance order, the magnet MG4 of the standby portion 5c is driven to feed the ticket blank 1a to the MS read-write unit 5a while the roller 57 is engaged with the upper belt 52. Through the MS read-write unit 5a, the ticket blank 1a is fed while it is sandwiched between the lower and lower belts 52 and 53, in the course of which the data are magnetically recorded on the magnetic stripe 11 of the ticket blank 1a and read therefrom by the read head 51. Then, the ticket blank 1a is ejected by the ejection roller 55 into the printer unit 6 by way of the gate 54.

The printer unit 6 will now be explained with reference to Fig. 17.

In Fig. 17, reference numeral 60 represents a line thermal head for the thermal printing of the heat-sensitive ticket blank including the protective layer, shown in Fig. 1, 61 a platen that is located in opposition to the thermal head 60, 62 a lever for keeping the space between the thermal head 60 and the platen 61 constant, and MG5 a magnet for driving the lever 62.

Reference numeral 63 stands for a feed belt for feeding the printed ticket 1a toward the ejection port 23, 64 a feed belt for carrying the printed ticket 1a to the hopper (internal stacker) 22, 65 a gate for guiding the printed ticket 1a to the hopper 22 or the discharge port 23, and MG6 a magnet for driving the gate 65 for switching-over.

Reference numeral 66 denotes a gate for guiding the printed ticket 1a to the reject box 28 or the ejection portion 23, MG7 a magnet for driving the gate 66 for switching-over, and PM4 a pulse motor for driving

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the feed belt 64, etc.

Explaining this operation, the ticket blank 1a fed from the MS unit 5 strikes on the thermal head 60 where its leading end is properly positioned and whence it is fed to the platen 61, in the course of which it is linearly printed.

In order to eject the ticket blank 1a into the ejection port 23, the magnet MG6 is put on to locate the gate 65 at a position shown by a dotted line in Fig. 17. The gate 66 is then located at a position shown by a solid line in this figure, so that the ticket 1a can be ejected into the ejection port 23. For ejection into the hopper 22, on the other hand, the magnet MG6 is put off to locate the gate 65 at the position shown by a solid line in Fig. 17, thereby guiding the ticket 1a into the hopper 22.

If the ticket is rejected due to some error in magnetic recording, etc., on the other hand, the magnet MG7 is then put on to locate the gate 66 at the position shown by a dotted line in Fig. 17, thereby guiding that ticket 1a into the reject box 28.

In what follows, the printer unit 5 will be explained more specifically with reference to Figs. 18, 19 and 20.

As shown in Figs. 18 and 19, the thermal head 60 is made up of a thermal line head including an array of heat elements corresponding to one line, which are arranged in the axial direction of the platen 61, and is attached to a bracket 600 by means of a fixing screw 600-1. At both ends of the bracket 600 there are positioning shafts 601 and 602, and on the bracket 600 there are a pin 603 and a sheet spring 604.

On the other hand, the printer unit 6 is provided with a swing lever 606 that swings around its fulcrum 607. This swing lever 606 is provided with a hanger 608, and biased counterclockwise (see Fig. 18) by a spring 605. This hanger 608 receives both the pin 603 and the sheet spring 604 at its center, as shown in Figs. 19(A) and (B), and is provided with a positioning groove 609 that comes into contact with the bracket 600. The printer unit 6 is also provided in its frame with a positioning groove 610 that engages with the positioning shaft 602 of the bracket 600.

Further, an axis 61a of the platen 61 opposite to the thermal head 60 is provided with a lever 62 that swings around an axis X to force up (the printing line portion of) the thermal head 60 against the biasing force of the spring 605. This lever 62 is limited by a stopper 620 in terms of the position at which it swings clockwise in Fig. 18, biased clockwise by a spring 621, and driven counterclockwise by the magnet MG 5 through a lever X.

In such an arrangement, the lever 62 abuts against the stopper 620 by the spring 621, so that it can be limited in terms of the position at which it swings, thereby spacing the thermal head 60 about 0.1-0.2-mm away from the platen 61.

At this time, the tickets 1a ejected through the ejection rollers 55 of the MS unit 5 abut against the diagonally positioned thermal head 60, so that their leading ends can be in alignment.

Subsequent driving of the magnet MG 5 causes the lever 62 to swing clockwise around the axis X through a shaft X of the lever X that swings around an axis Y, thereby releasing the upward displacement of the thermal head 60. This in turn causes the thermal head 60 to be engaged with the platen 61 following the biasing force of the spring 605, enabling the platen 61 to be fed and so making thermal recording by the thermal line head 60 possible.

At this time, the location of the thermal head 60 with respect to the platen 61 is assured by engaging the positioning shaft 602 of the bracket 600 - to which the thermal head 60 is fixed - within the positioning groove 610 in the frame.

The horizontal location of the thermal head 60, on the other hand, is assured by engaging the pin 603 extending from the center of the bracket 600 within the positioning groove 609 in the center of the hanger 608 and biasing the opposite side thereof by means of the sheet spring 604, as shown in Fig. 19, thereby making the positioning of the thermal head 60 easier.

Further, the thermal head 60 is designed to be rotatable around the pin 603 fitted within the positioning groove 609 in the hanger 608, as shown in Fig. 19(B), so that it can turn following the platen 61, keeping printing pressure constant. This in turn enables printing density to be kept constant in dependence on a paper thickness variation, eccentricity of the platen 61, and so on.

The attachment or detachment of the bracket 600 that supports the thermal head 60 in place will now be explained more specifically with reference to Fig. 20. For detachment of the thermal head 60 from the swing lever 606 of the bracket 600 that supports it in place, the spring 605 is removed to swing the swing lever 606 upward in Fig. 18. Then, the bracket 600 that fixes the thermal head 60 in place is disengaged from the platen 61 and from within the positioning groove 610. Subsequently, a push is given by a finger to the sheet spring 604 of the bracket 600, as shown in Fig. 20(A) to deform the sheet spring 604, thereby detaching the pawl of the sheet spring 604 from the hanger 608. Finally, the bracket 600 with the thermal head 60 fixed to it is turned downward, whereby the bracket 600 with the thermal head 60 fixed to it can be disengaged from the hanger 608.

The attachment of the swing lever 606 to the bracket 600 is achieved in much the opposite manners as mentioned above, i.e., by fitting the pin 603 extending from the bracket 600 into the positioning groove 610 in the hanger 608 and then forcing therein the side of the bracket 600 on which the sheet spring 604 is attached.

After that, while the spring 605 is attached to the swing lever 606, the positioning shaft 602 of the

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bracket 600 is fitted in the positioning groove 610 in the frame, so that the thermal head 60 and platen 61 can be regulated in terms of their positions.

Thus, the attachment or detachment of the thermal head 60 to or from the associated bracket 600 is easily achievable by providing the positioning groove 609 in the hanger 608 and engaging or disengaging the pin 603 and sheet spring 604 of the bracket 600 within or from that groove 609.

Further, the printing line of the thermal head 60 and the platen 61 can be regulated in terms of their positions by engaging the positioning shaft 602 of the bracket 600 within the positioning groove 610 in the frame.

Still further, the line thermal head 60 is designed to be rotatable around the positioning groove 610 in the hanger 608 in the line direction, thus enabling printing pressure and density to be made uniform in the horizontal direction.

In addition, the printer unit can be achieved simply and inexpensively, because the mechanism for attachment or detachment of the thermal head 60 is made integral with the mechanism for making density uniform.

In what follows, how to ticket will be explained chiefly with reference to Figs. 6 and 7.

In the pre-feeder unit 4, the continuous paper 1 held in the ticket blank holders 3a and 3b is first cut, biased and put in a ready-for-further-feeding state.

Upon receiving a ticketing command, the pre-feeder unit 4 is actuated to feed each cut ticket blank 1a to the MS unit 5 where it is biased and data is magnetically recorded on its magnetic stripe 11 and then it is fed to the printer unit 6.

In the printer unit 6, the data is thermally recorded by the thermal head 60 on the ticket blanks 1a with their leading ends in order, and they are then ejected into the ejection port 23 or the hopper 22.

Following the feed of the cut ticket blanks 1a by the pre-feeder unit 4, the next continuous paper 1 may be fed, positioned and separated by cutting into individual ticket blanks 1a for making ready-to-feed. In other words, the next cut ticket blanks 1a are made ready-for-further-feeding while the preceding cut ticket blanks 1a are magnetically recorded and thermally printed, thus improving the issuance speed of tickets.

The ticket blank holders 3a and 3b hold airliner ticket blanks in the form of continuous paper, and so the management of the securities can not only be easily achieved, but something wrong can immediately be found as well. In addition, the continuous paper is separated by cutting into individual ticket blanks 1a, and so not only is it assured that they are magnetically recorded and thermally printed, but there is also no need of separating the continuous paper into individual ticket blanks after ejection.

While the instant embodiment has been described with reference to airliner tickets, it is understood that the invention is applicable to other securities or tickets such as passenger or reservation tickets.

Next, another embodiment of the pre-feeder unit 4 will be explained with reference to Figs. 21 and 22.

As shown in Figs. 21(a) and 21(b) that are the perspective and side views of such an embodiment, a gear 425 is coaxially fixed to a shaft of a feed roller 42a, which in turn meshes with a gear 423. The gears 425 and 423 are respectively in mesh with gears 421 and 422 that are mounted on their driving shaft through one-way clutches 421a and 422a, respetively. The driving shaft is provided at its one end with a toothed pulley 420. It is noted that pulleys 410, 411 and 420 are connected with one another by a belt 43a.

The one-way clutches 421a and 422a are mounted such that the gears 421 and 422 are each rotated in the opposite direction. To put it another way, when the pulley 420 is rotated in the direction shown by an arrow A, the one-way clutch 422a disengages the gear 422 to keep it idle, while the one-way clutch 421a is actuated to rotate the gear 421 and thereby rotate the gear 425 through the gear 423, so that the feed rollers 420 can be rotated in the feed direction of the continuous paper 1.

When the pulley 420 is rotated in the direction shown by an arrow B, on the other hand, the one-way clutch 421a disengages the gear 421 to keep it idle, while the one-way clutch 422a is actuated to rotate the gear 422 and then the gear 425, so that the feed roller 42a can again be rotated in the feed direction of the continuous paper 1.

According to the pre-feeder unit 4 of the construction mentioned above, the continuous paper 1 fed from the ticket-blank holder 3a is fed in the feed direction by the forward rotation, i.e., rotation shown by the arrow A, of the motor PM1, because the pulleys 410 and 420 are then rotated in the direction shown by the arrow B to rotate the feed rollers 41a and 42a in the same direction.

With the continuous paper 1 fed to a predetermined position, the motor PM1 stops, and then rotates in the opposite direction, i.e., the direction shown by the arrow B in Fig. 21. Thereupon, the pulleys 410 and 420 are rotated in the direction shown by the arrow B and, as illustrated in Fig. 22(B), this then causes the rotation of the feed roller 41a in the opposite direction and the rotation of the feed roller 42a in the forward direction.

Consequently, the continuous paper 1 is pulled and tensioned regardless of the presence or absence of looseness, because the feed rollers 41a and 42a are each rotated in the opposite direction.

Then, the continous paper 1 is cut along the perforations 17 into individual ticket blanks 1a by the cutter 47a.

The tickets 1a are then carried by driving the feed

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rollers 41a and 42a to the MS read-write unit 5.

In the ensuing description, a further embodiment of the pre-feeder unit 4 will now be explained with reference to Figs. 23 and 24.

The construction shown in Fig. 23 follows that of the embodiment illustrated with reference to Fig. 21, with the exception that when the motor PM1 is rotated in the opposite direction (the direction shown by an arrow B), the feed roller 41a is caused to stop rather than rotate in the opposite direction. According to the embodiment shown in Fig. 21, when the feed roller 41a is rotated in the opposite direction, the continuous paper 1 is cut, but the rest of the continuous paper 1 may be fed back in that moment. The instant embodiment is provided to avoid this.

More specifically, the axis of the feed roller 41a is provided at its one end with a toothed pulley 410 through a one-way clutch 410a, as illustrated in Fig. 23. Consequently, it is when the motor PM1 is driven in the forward direction (or in the direction shown by an arrow A) that the one-way clutch 410a is so actuated that the feed roller 41a can rotate in the forward direction (or in the direction A). In contrast, it is when the motor PM1 is driven in the opposite direction (or in the direction shown by an arrow B) that the one-way clutch 410a disengages the pulley 410, so that it can be kept idle, thereby keeping the feed roller 41a from rotation.

When the motor PM1 is driven in the opposite direction (or in the direction B), the feed roller 42a is rotated in the feed direction, but the feed roller 41a is not rotated by the rotational force of the pulley 410. Consequently, a sag in the continuous paper 1 is temporarily pulled, and so tension is imparted to the continuous paper 1. Subsequently, the continuous paper is fed by the feed roller 42a under that tension, so that, as shown in the time chart presented in the form of Fig. 24(B), the continuous paper 1 can be cut along the perforation 17 by the cutter 47a at a timing at which that sag is pulled by the feed roller 41a just after the backward driving of the motor PM1.

The feed roller 41a is then not rotated, and so the feeding-back of the rest of the continuous paper 1 is avoided, thus enabling the distance to the next cutting position to be reduced. The time reduction achieved per ticket is slight, but the total ticketing time can be much reduced in the case of issuing a large number of tickets sequentially.

It will now be described how to regulate the position of the MS unit 5 at which data recording is initiated.

As shown in Fig. 25(A), the main part of the MS unit 5 is built up of a sensor SS for sensing the leading end of each ticket blank 1a, a write head 50 disposed behind the sensor SS by a predetermined distance Ll, a read head 51 located behind the write head 50 and a sensor ES located behind the read head 51 for sensing the trailing end of each ticket blank 1a.

With each ticket blank 1a - that has been fed from the ticket blank holder 2a and is now ready to leave in the pre-feeder unit 4 - fed out of the pre-feeder unit 4 as per ticketing instructions, it is fed by the belt mechanism 52 to the passage for the MS unit 5. When the ticket blank 1a is carried to a given position through a predetermined distance S after its leading end has been sensed by the sensor SS, as shown in Fig. 25(B), boarding reservation data (departure date and time, flight number, passenger's name, and so on) sent out of external equipment is magnetically recorded by the write head 50 on the magnetic stripe 11 of the ticket blank 1a.

The data recorded on the magnetic stripe 11 of the ticket blank 1a is reproduced by the read head 51 for checkup. If there is no error, the ticket blank 1a is fed to the printer unit 6 where the data is printed and then it is sent out of the issuance port. Then, when the print is ended, the completion of ticketing is notified. This enables the succeeding ticket 1a to be ready to leave the pre-feeder unit 4.

It is here to be noted that the position of a predetermined distance S taken by the ticket blank 1a after its leading end has been detected lies at the position of a distance L2 from the leading end of the magnetic stripe 11 to the write head 50 (i.e., L2=S-L1), and this distance L2 must lie within a certain tolerable range with respect to a predetermined size.

In other words, the writing of the data onto the magnetic stripe by the write head 50 is initiated after the lapse of a time period t from the detection of the leading end of the ticket 1a by the sensor SS to the time at which the leading end of the ticket blank 1a would reach the position of the distance S.

When the distance L2 is too short, reading is unlikely to occur because some difficulty is involved in the synchronization of the read signals, whereas when it is too long, some data are unlikely to be recorded because the recording zone of the magnetic stripe 11 becomes narrow. For assuring stable reading and recording region, there are thus the ISO and JIS standards (e.g., 7.44 mm±1.0 mm).

However, the given distance S depends on the accuracy of the spacing between the sensor SS and the write head 50 and, besides, there is an error in the accuracy of mechanical feeding by the belt mechanism 52, which in turn gives rise to an error in the distance L2. For this reason, after data is actually recorded on the ticket blank 1a, the recording initiation position from the leading end of the magnetic strip of the ticket 1a is measured to regulate the quantity of the error alone. So far, this regulation has been achieved by the following procedures.

The first procedure, as already mentioned above, involves recording data on the magnetic stripe 11 of the ticket 1a and visualizing the magnetic pattern with the use of a developer to measure the distance L2 to the write start position on the ticket blank 1a under a

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scaled magnifier. In the process of this development, the magnetic stripe 11 is treated with a developer composed of a mixture of a volatile liquid with magnetic powders. Then, the volatile component volatilizes, leaving the magnetic powders on the data part.

When the results of this measurement teach that the error deviates from the prescribed value, the relative distance between the sensor SS and the write head 50 is adjusted as by changing the position at which the sensor SS is mounted, again, followed by magnetic recording and development to measure the recording start location. In other words, the first procedure is a sort of the method of trial and error.

The first procedure may be achieved by a mere displacement of the position of the sensor SS is mounted but, in this case, it is sometimes required to provide some mechanism for the fine adjustment of the location of the sensor SS.

In the second procedure that is similar to the first procedure in that data is recorded on the magnetic stripe 11 of the ticket blank 1a and then developed, the distance of movement of the ticket blank 1a from the time where the sensor SS detects the leading end of the ticket 1a to the recording start time.

To be more specific, an encoder, not illustrated, is provided on the driving pulley of the belt mechanism 52 for feeding the ticket 1a. Then, the distance of movement of the ticket 1a is calculated. It is when the sensor SS reaches a given calculated value t after detecting the leading end of the ticket blank 1a that the write head 50 starts to record.

This is followed by development and measurement. The recording start position, when there is an error, is regulated by increasing or decreasing this calculated (or set) value.

It is noted that the second procedure may also be achieved by using a stepping motor for driving the driving pulley in place of the encoder, but there is a need of increasing or decreasing the stepping number of the motor.

A problem with the above-mentioned conventional procedures, however, is that they are all time- and labor consuming, because of involving the steps of development, measurement and regulation after the recording of data on the magnetic stripe of a ticket blank.

According to the instant embodiment, this problem is solved by making it possible to regulate automatically the recording start position on a ticket blank by the mere insertion of the ticket blank.

Fig. 26 is a block diagram presented for achieving this. In Fig. 26, a control panel 26 is similar to that shown in Figs. 4 and 5, and includes a correction-mode indicating button 260 for setting the mode for determining a correction value for the recording start position on a ticket 1a. A clock generator 75 generates a clock signal of a frequency F.

A clock counter 76, when the correction-mode indicating button 260 is pushed down, is actuated to count the number of all clock signals M sent out of the clock generator 75 from the time a sensor SS detects the leading end of the ticket 1a to the time the sensor SS detects the trailing end of the ticket 1a. Fig. 29(b) represents the timings of the sensor-detected signal and the clock signals, and counts the time during which the ticket 1a of accurate size passes by the sensor SS by the clock signals of frequency F. This is to measure the feed speed accurately.

A RAM 77 stores the value of the frequency F of the clock signals sent out of the clock generator 75 and a recording frequency F of data "0" generated from a data-generator block 71 at a correction mode to be described later. A data-reception block 78 receives the data to be recorded, which is sent out of an external device.

A main control block 70 includes a CPU and a control program memory, and the CPU controls each block according to the control program in the memory, feeding a ticket blank 1a, making a given record on the magnetic stripe 11 of the ticket blank 1a, reproducing the record for checkup, and printing data on the ticket blank 1a for ejection.

Further, the CPU, when the correction-mode-indicating button 260 is pushed down, is actuated to detect an error in the recording start position by a series of controls shown in Fig. 27, and thereby execute the automatic correction of the recording start position.

Reference numeral 72 stands for a motor driver that drives a motor M upon receipt of instructions from CPU 70 to drive feeding belts 52 and 53. Reference numeral 73 denotes a sensor amplifier that amplifies the output of the sensor SS for output to CPU 70, and 74 represents an amplifier that amplifies the output of a reproduction head 51 for output to CPU 70.

Fig. 27 represents the functions of CPU 70 of Fig. 26 in a blocked form, and the functions of the control block 70 will now be explained with reference thereto.

In Fig. 27, a cycle counter block 70-1 is constructed from a peak detector sub-block 80, a cycle detector sub-block 81 and a counter 82, and a calculator block 70-2 is built up of a feed speed calculator sub-block 83, a recording density calculator sub-block 84, a recording start position calculator sub-block 85 and a correction time calculator sub-block 88. In what follows, the function of each block will be explained.

A feed time setting block 92 is made up of a memory, and initially set there is a theoretical write start time t until the leading end of a ticket blank 1a is detected to start recording data, wherein t = Distance S to the recording start position to be described later/Feed Speed V. However, this preset t, when the correction time Δt to be described later is found, is replaced by a correction time $t'(=t+\Delta t)$.

A block 71 (see Fig. 26) for generating data at the correction-mode time stores data "0" and "1" and, when the correction mode is indicated by pushing

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down the correction-mode-indicating button 260, is actuated to generate the data "0" that is recorded from the time the sensor SS detects the leading end of a ticket blank 1a to the time the data-recording start time (i.e., the feeding time t of the ticket blank 1a) and the data "1" that is recorded from the data-recording start time. Fig. 29(a) represents the timings of the sensor-detected signals and the recording signals. It is noted that the magnetic inversion cycles of the data "0" and "1" lie at a ratio of 2 to 1, and that the magnetic inversion cycle of the data "0" or the recording frequency is f.

In the cycle counter block 70-1, the peak of the output signal corresponding to the magnetic inversion of the data read on the read head 51 is detected by the peak detector sub-block 80 from the leading end of the ticket blank 1a having the data "0" and "1" recorded thereon, as shown in Fig. 29(c)(1), and the number of all cycles N until the changing of the data from "0" to "1" is detected is counted by the counter 82, as shown in Figs. 29(c)(2) and 29 (c)(3).

In other words, the counter 82 counts the changing cycle of the data from "0" to "1" in terms of the number of all cycles detected by the cycle detector sub-block 81. Fig. 29(c)(4) represents a signal detecting that the peak signal cycle is reduced because of the changing of the data from "0" to "1".

In the feed speed calculator sub-block 83, an actual feed speed V given by LF/M is found, wherein F is the clock frequency read from RAM 77, M is all the clock signals counted by the clock counter and L is the length of the ticket blank 1a.

In the recording density calculator sub-block 84, a recording density given by f/V is found, wherein f is the recording frequency read from RAM 77 and V is the actual feed speed.

The recording start position calculator block 85 is built up of a distance calculator 86 and a comparator 87. In the distance calculator 86, a distance S from the sensor SS to the recording start position given by NV/F is found, wherein N is the total cycle number N counted by the cycle calculator block 70-1 and f/V is the recording density calculated by the recording density calculator sub-block 84. In the comparator 87, the absolute value ΔS of a difference between the measured distance S and a preset distance S_0 to the recording start position is found and compared with a prescribed value S_L for an allowable tolerance limit set in an allowable-value setting block 91 to make determination of whether $\Delta S>S_L$ or $\Delta S \leqq S_L$. When $\Delta S>S_l$, the main control block 71 is notified of the "need" of correcting the recording start position, and when $\Delta S \leqq S_L$, the main control block 71 is notified of the "no need" of correcting the recording start position.

The correction time calculator block 88 includes a correction data calculator 89 and a correction feed time calculator 90, and the correction data calculator 89, when there is the "need" of correcting the recording start position, calculates the correction time Δt given by ΔS/V, where ΔS is the difference found by the comparator 87 and V is the feed speed, according to instructions from the main control block 71. With the correction time Δt found, the correction time feed time calculator block 90 is actuated to correct the feed (write start) time t that is initially set in the feed time setting block 92 with the correction time Δt. That is, the correction feed time $t'=t \pm \Delta t$ is calculated.

In the ensuing description, the operation of the instant embodiment will be explained with reference to the flow chart of Fig. 28.

(1) First, the power source of the apparatus is put on and the correction-mode-indicating button 260 is pressed down to set the correction mode.

Then, a ticket blank 1a (of accurate length L) for testing purposes is inserted through the inserting port 21, shown in Figs. 4 and 5, whence it is fed through the MS unit 5 to the unit 5c where the manually inserted ticket blank stands for further feeding, as is the case with the cut ticket blank. From this unit 5c, it is fed to the MS read-write unit 5a. When the leading end of the ticket blank 1a is here detected by the sensor SS, the clock counter 76 is triggered to count the number of all clock signals (of frequency F) generated until the sensor SS detects the trailing end of the ticket blank 1a. Then, the accurate actual feed speed V is found in the feed speed calculator block 83 from the length L of the ticket blank 1a and the total clock signals M; in other words, it is calculated from V=L x F/M.

(2) Further, the recording density f/V is found in the recording density calculator block 84 by dividing the recording frequency f read from RAM 77 by the feed speed V.

(3) From the time the sensor SS detects the leading end of the ticket blank 1a, on the other hand, recording is made with the use of the feed (write start) time t initially set in the feed time setting block 92. Before the recording start time t, the main control block 70 outputs continuously the data "0" from a data generation unit 71 that works at the correction value-determining time for recording them on the magnetic stripe 11 of the ticket blank 1a by the write head 50. After the recording start time t, the data is changed to "1" for recording.

(4) Now, the data "0" is read by the read head 51 from the leading end of the fed ticket blank 1a, and the counter 82 counts the total cycle number N until the cycle detector sub-block 81 detects that the data is changed from "0" to "1".

(5) The counted total cycle number N and the recording density f/V calculated at Step (2) are fed to the recording start position calculator block 85, where the distance S to the recording start position is found by the distance calculator 86; in

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other words, the distance is calculated from S=N x V/f.

(6) In the comparator 87, the absolute value ΔS ($=S-S_0$) of the difference between the distance S and the preset distance S_0 to the recording start position is found and compared with the prescribed value S_L in the allowable value setting block 91 to provide determination of $\Delta S>S_L$ or $\Delta S \leqq S_L$, notifying the main control block 71 of the "need" or "no need" of correcting the distance S. When there is no need, no correction occurs. Hence, subsequent-recording of the ticket blanks 1A is done with the use of the write start time t that is initially set in the feed time setting unit 12.

(7) When there is the "need" of correcting the distance S, ΔS is divided by the feed speed V - that is found by in the feed speed calculator block 83 - by the correction data calculator 89 in the correction time calculator block 88 to find the correction time Δt ($=\Delta S/V$).

(8) Then, the intially set recording start time t is read form the feed time setting block 92, and the correction feed time $t'=t+\Delta t$ is found in the correction feed time calculator 90 by the correction time Δt. The correction feed time t" is then renewed in the feed time setting block 92 in place of the initially set feed time t.

(9) After that, the ticket blank 1a is fed to the printer unit 6 where the correction value (i.e., ΔS) is printed for issuance through an issuance port. This enables the operator to confirm the quantity of regulation. Finally, the correction-mode-indicating button 260 is again pressed down to release the correction mode, making the correction of the recording start position complete.

After the passing of the time t' from the time the sensor SS detects the leading end of the ticket blank 1a, the write head 50 starts to write the data with the use of the thus corrected write start time (feed time) t', whereby the data is written onto the ticket blank 1a from the position away from the leading end by the given distance Ll. Such correction is usually done when hardware is forwarded from plants or in-situ replacement of the whole or a part of the MS unit 5.

Therefore, the instant embodiment can dispense with some post-data-recording steps of development, measurement and regulation that are required for conventional correction procedures, and so can eliminate troublesome development and measurement works and works for regulating the distances of the sensor SS and write head 50 for correcting the recording start position on the ticket blank 1a.

While the instant embodiment has been described as making correction only when the difference ΔS, when found, exceeds the allowable value S_L, it is understood that only the feed time Δt corresponding to the difference ΔS may be corrected irrespective of the allowable value S_L.

Claims

1. A ticket on which ticketing data can be both magnetically recorded and printed, including a base (13), a heat-sensitive layer (14) provided on one side of the base, a protective layer (15) provided on the heat-sensitive layer and a magnetic recording layer (11) provided on the other side of the base.

2. A ticket as recited in claim 1, wherein the magnetic recording layer (11) is provided on a protective layer (16) laminated on the other side of the base.

3. A ticket as recited in claim 1 or 2, wherein the heat-sensitive layer (14) contains an irreversible pigment.

4. A ticket as recited in any preceding claim and being an airline ticket.

5. A continuous medium for the production of tickets, comprising a string of tickets as claimed in any preceding claim, held together by perforated portions.

6. A continuous medium according to claim 5 and provided with cuts (18) inwardly from both ends of each perforation for assisting separation of the medium into individual ticket blanks.

7. A ticket printer for magnetically recording and printing ticketing data on ticket blanks, for issuance for instance as airline tickets, including:

   ticket blank holder means (3a,3b) for holding ticket blanks, each comprising a base, a heat-sensitive layer and a protective layer provided on one side of the base and a magnetic recording layer provided on the other side of the base,

   magnetic recording means (5) for magnetically recording ticketing data on the magnetic recording layer of the ticket blanks, and

   thermal printing means (6) for thermally printing the ticketing data on the heat-sensitive layer of the ticket blanks for issuance.

8. A ticket printer for magnetically recording and printing ticketing data on ticket blanks, for issuance, for instance as airline tickets, including:

   ticket blank holder means (3a,3b) for holding a continuous form of medium that can be separated along perforations into individual ticket blanks,

   pre-feeder means (4) for feeding the continuous form of medium from the ticket blank holder and cutting it along the perforations into individual ticket blanks,

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magnetic recording means (5) for magnetically recording ticketing data on the magnetic recording layer of each cut ticket blank, and

printing means (6) for printing ticketing information on each ticket blank.

9. A ticket printer as recited in claim 7, in which the holder means (3a,3b) is adapted to contain a continuous form of medium that can be separated along perforations into the said ticket blanks, and the printer further includes pre-feeder means (4) for feeding the continuous form of medium from the holder means and separating it along the perforations into the individual tickets.

10. A ticket printer as recited in claim 8 or 9, wherein the pre-feeder means (4) after feeding the continuous form of medium and cutting it along the perforations into individual ticket blanks, enables the blanks to stand ready for further feeding.

11. A ticket printer as recited in any of claims 8 to 10, wherein the ticket blank holder means (3a,3b) is located in a lower portion of the apparatus body and the magnetic recording (5) and printing (6) means are located in an upper portion of the apparatus body, so that the ticket blanks can be fed by the pre-feeder means (4) from the ticket blank holder means (3a,3b) to the rear of the magnetic recording means (5) in the upper portion of the apparatus body.

12. A ticket printer as recited in any of claims 8 to 11, pre-feeder means (4) is designed to feed the continuous form of medium until a perforation in the medium is located at a cutter position, and then to cut the medium by a cutter (47a,47b).

13. A ticket printer as recited in claim 12, wherein the pre-feeder means (4) is designed to apply tension to the continuous form of medium during cutting, pulling the medium on both sides of the perforation.

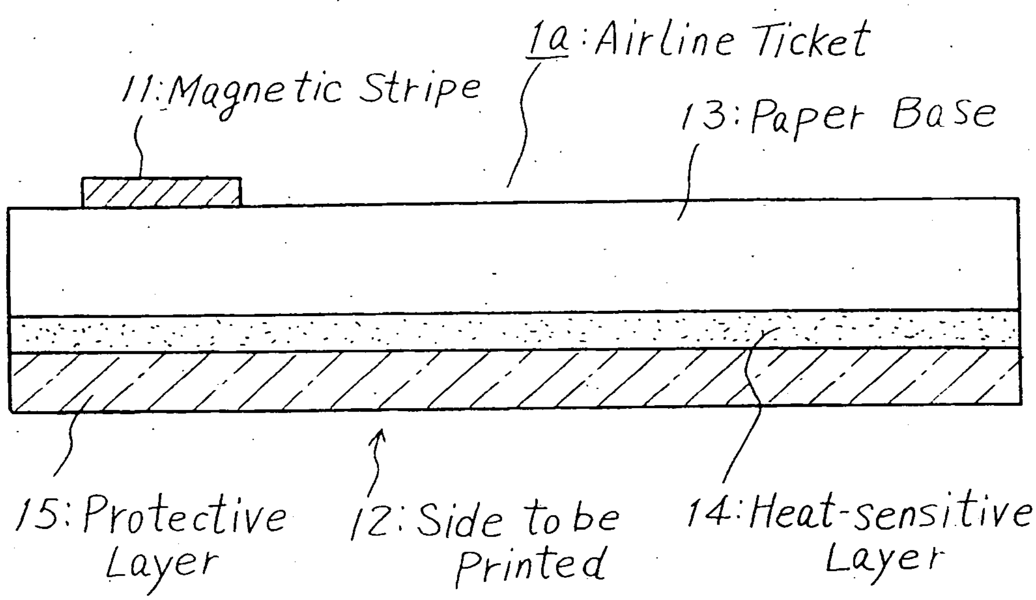
14. A ticket printer as recited in any of claims 7 to 13, wherein the pre-feeder means (4) is provided with a biasing mechanism (49) for biasing the ticket blanks to one side.

15. A ticket printer as recited in any of claims 7 to 14, wherein the magnetic recording means (5) includes a biasing mechanism that, while the cut ticket blanks are fed by a belt, biases the fed ticket blanks to one side.

16. A ticket printer as recited in any of claims 7 to 15, wherein the printing means (6) includes a printing mechanism (60) for positioning the leading ends of the magnetically recorded ticket blanks and then printing the ticket blanks.

FIG. 1

(A)



(B)

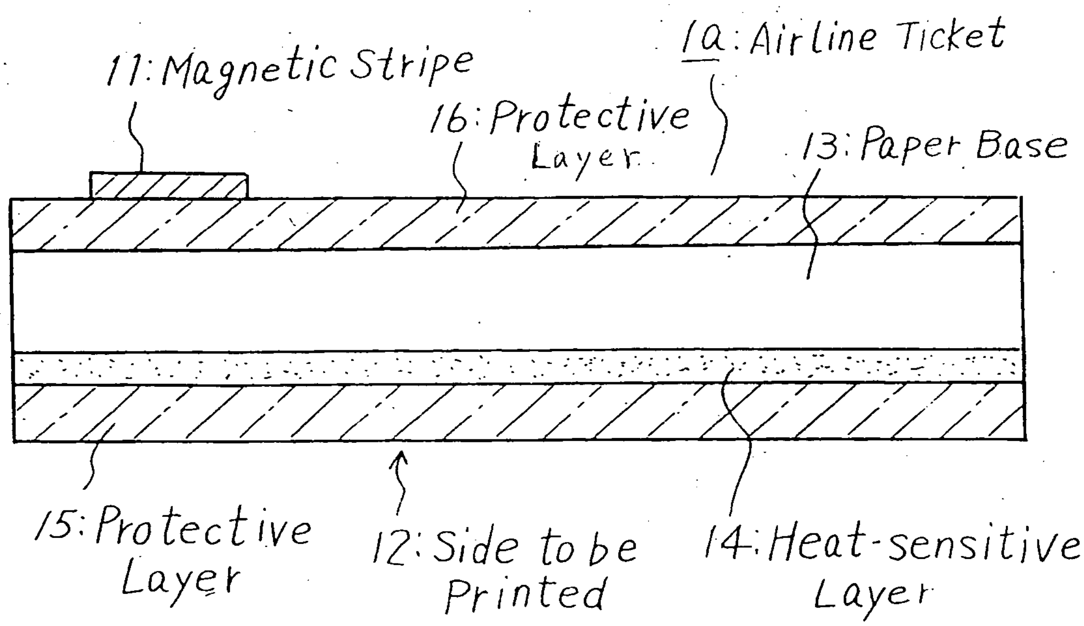


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FIG. 2

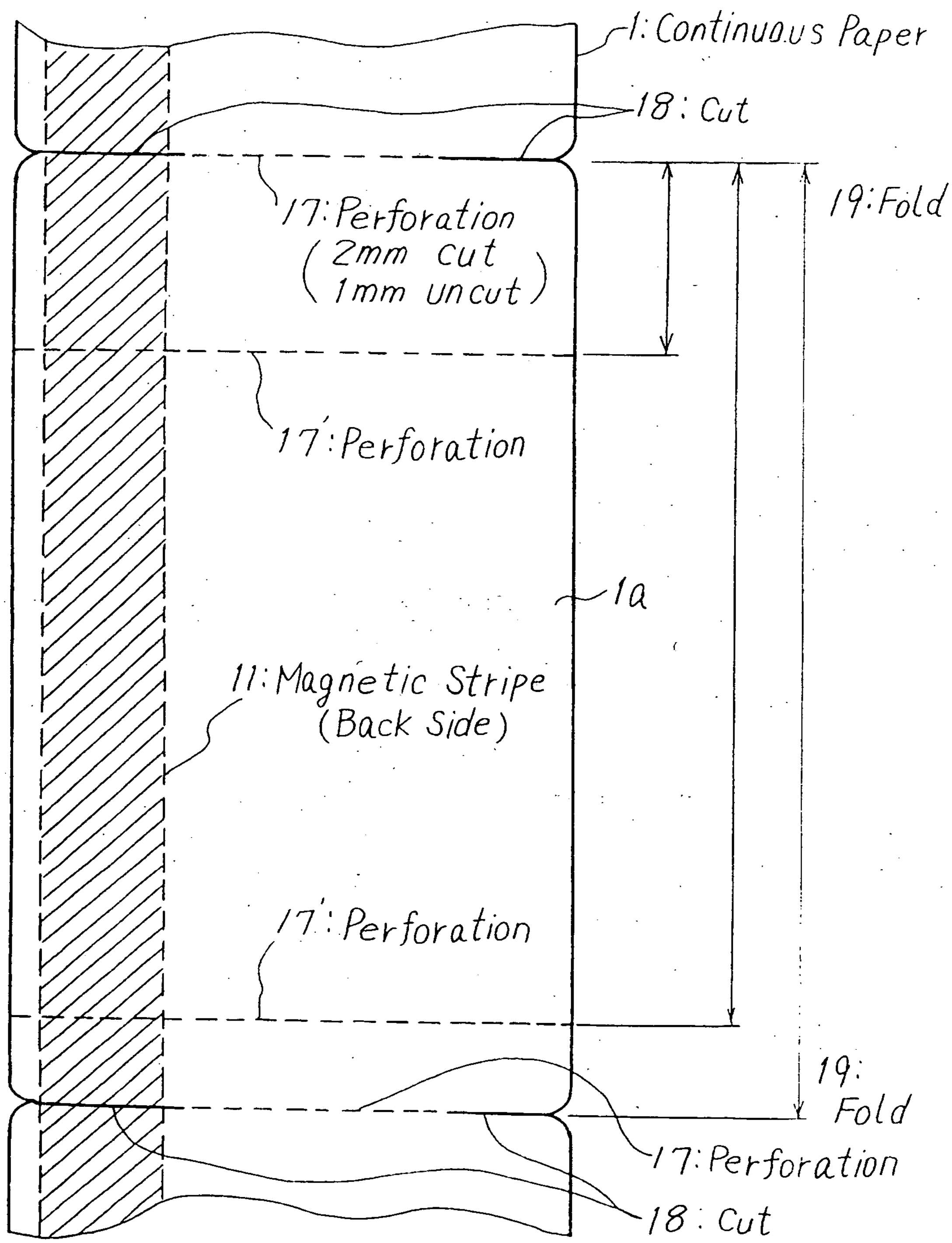

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FIG. 3

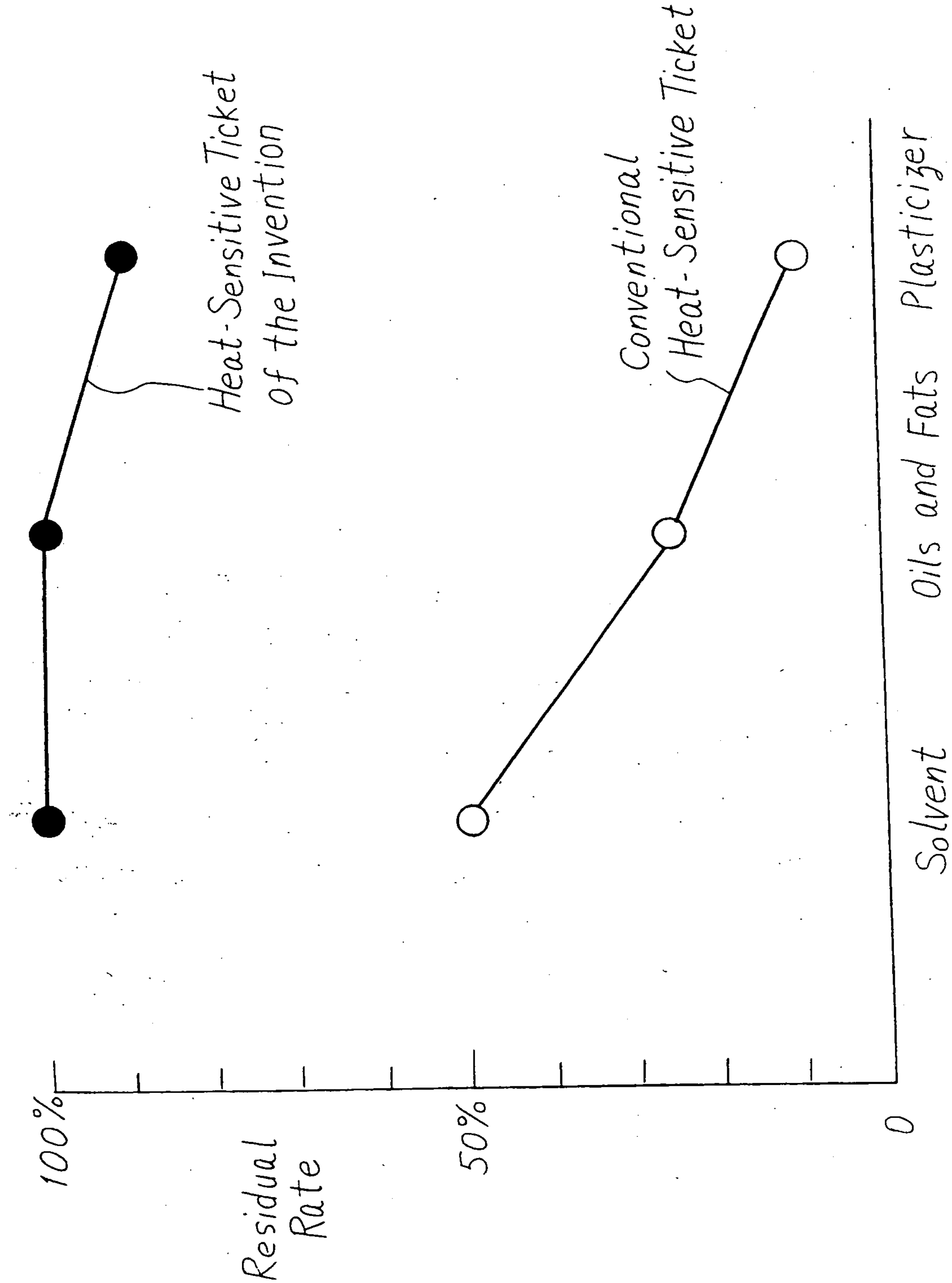

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FIG. 4

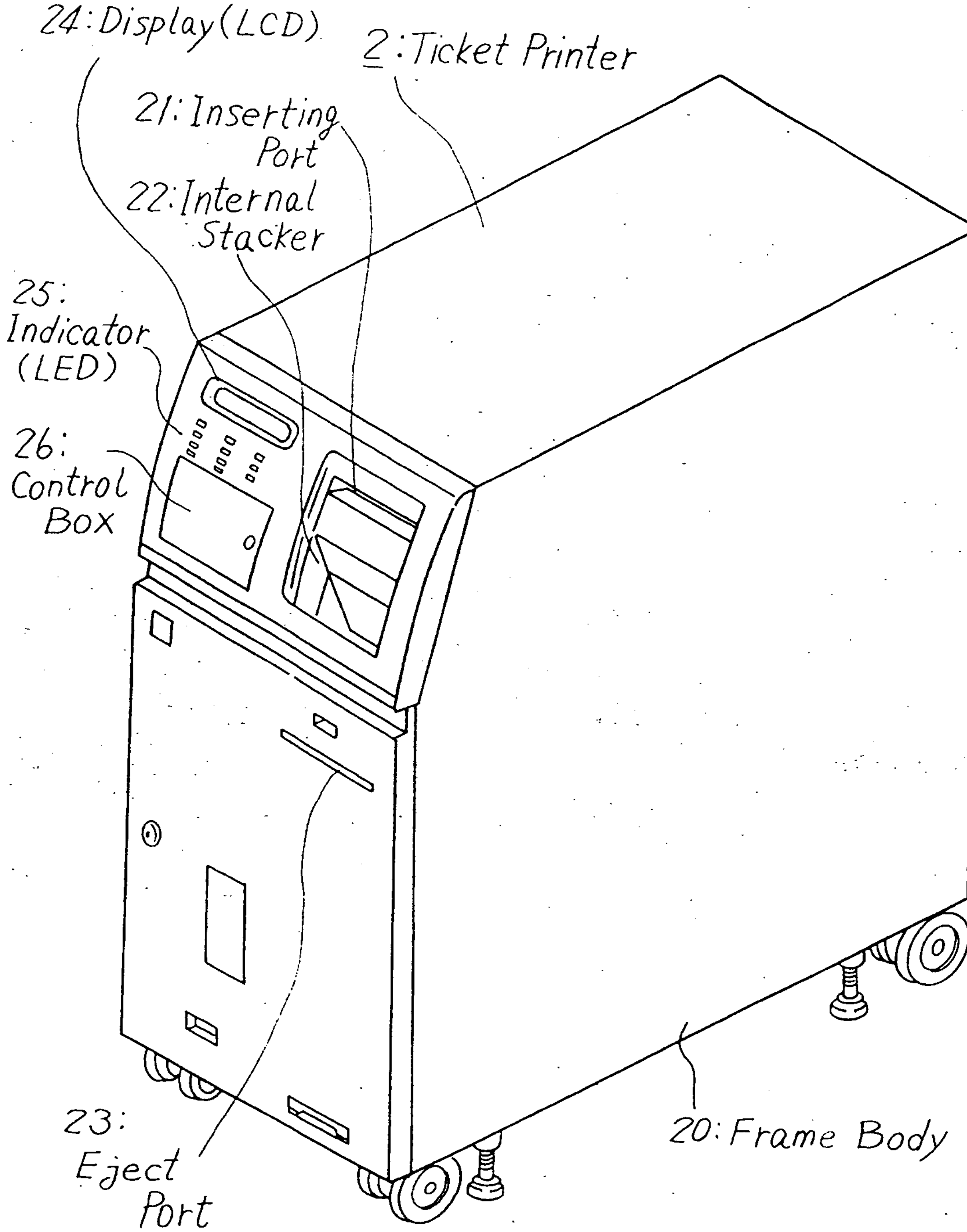

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FIG. 5

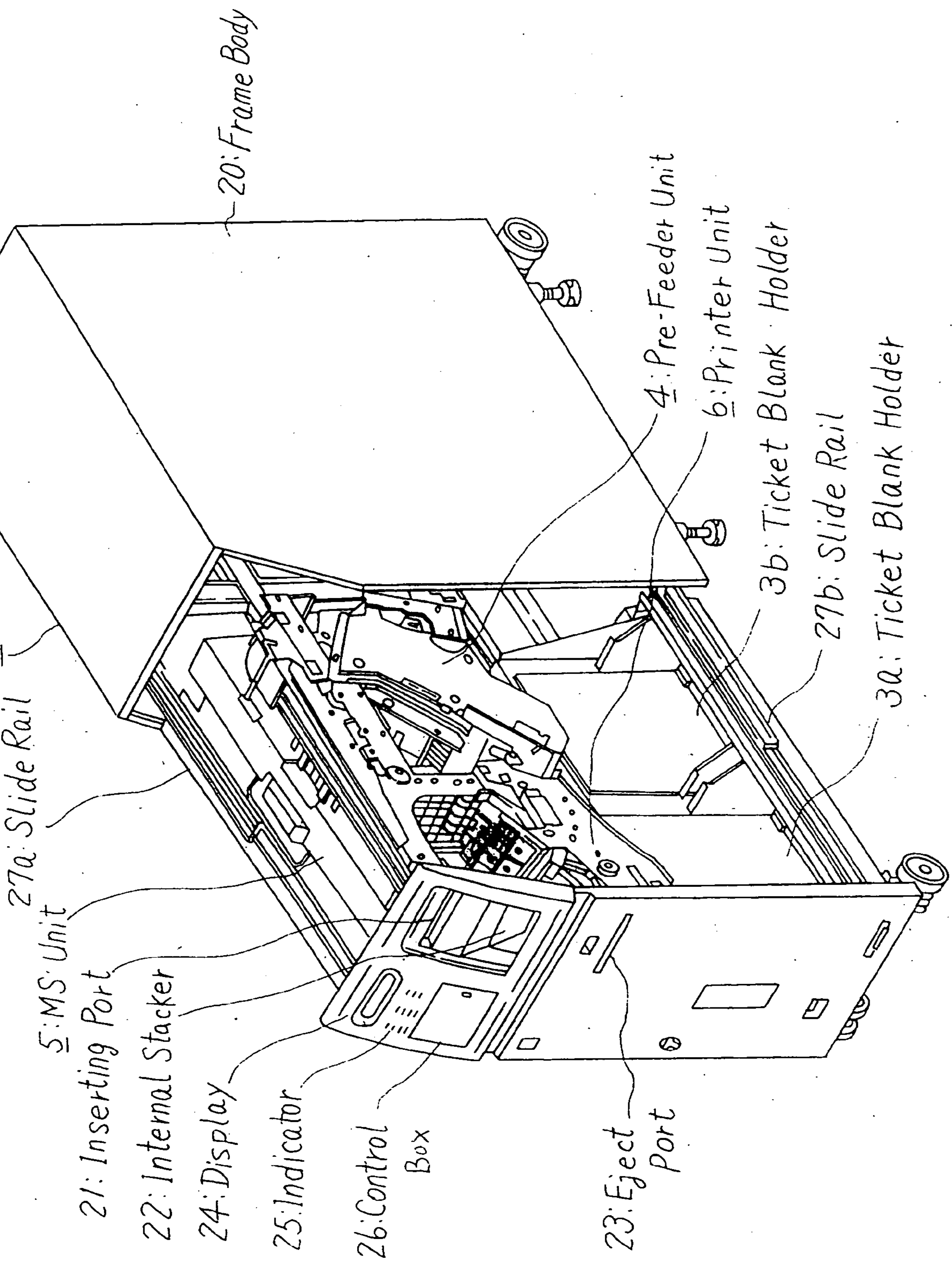

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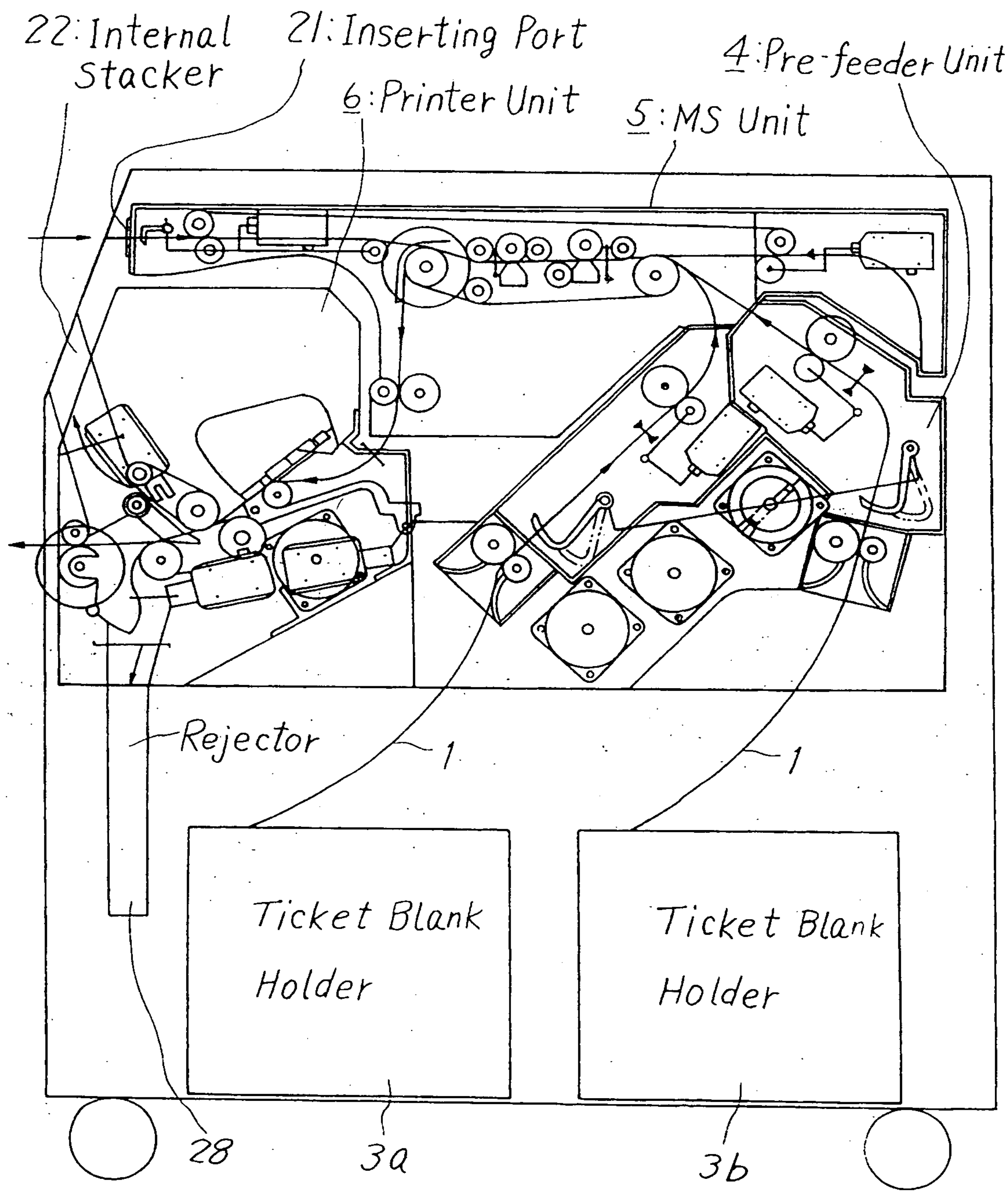
FIG. 6



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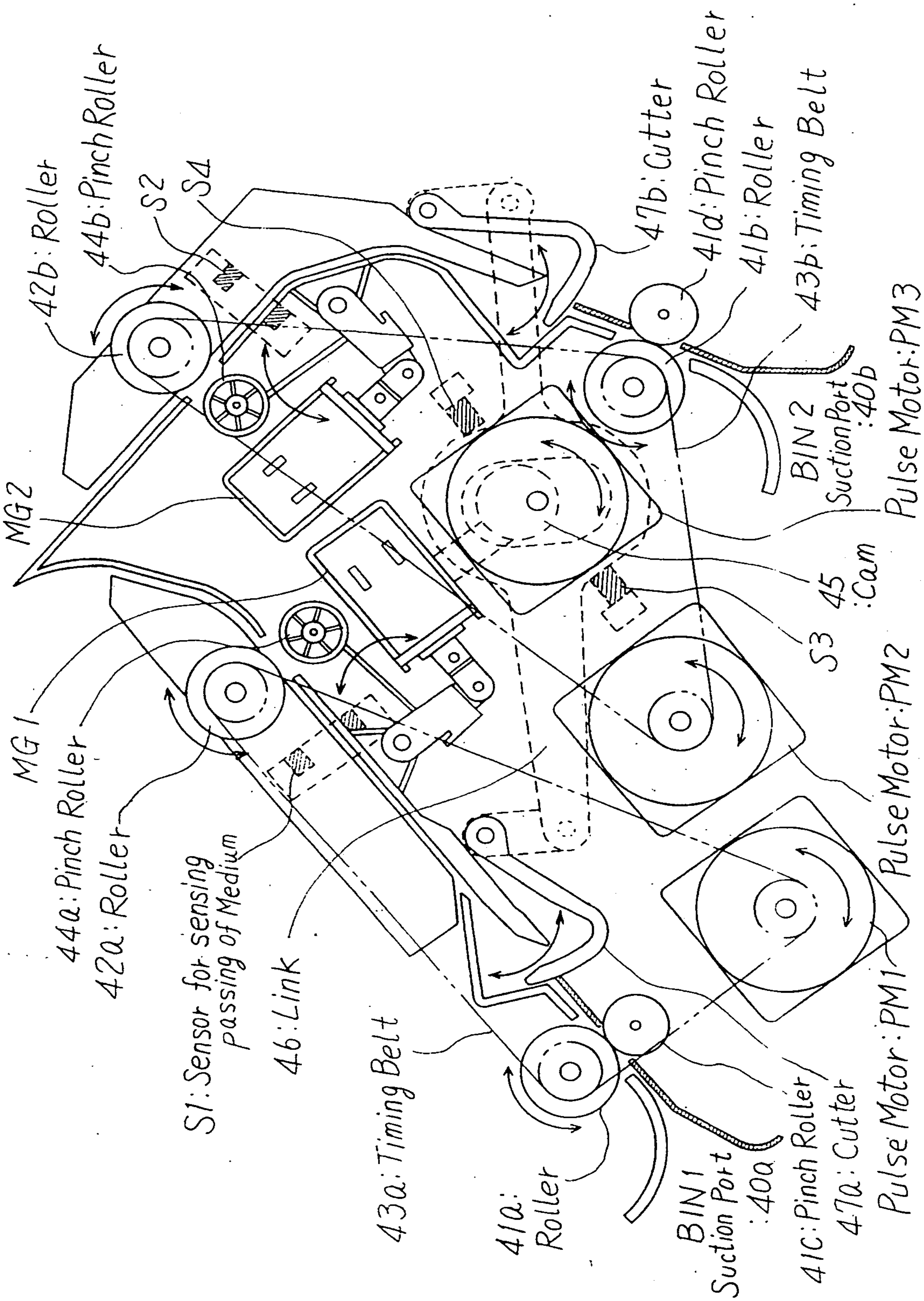
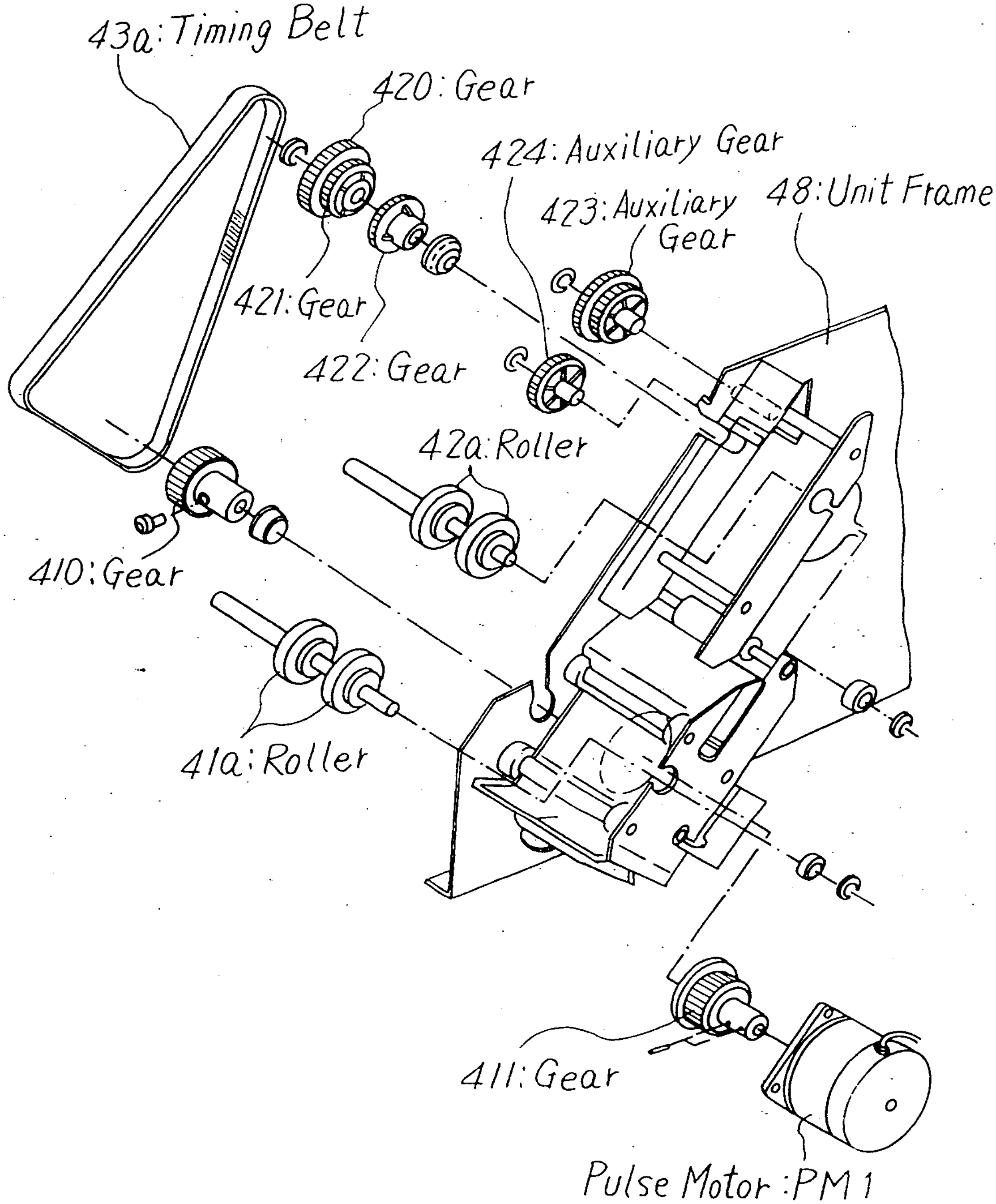


FIG. 7

BNSDOCID: <EP___0556071A2_I_>

FIG. 8



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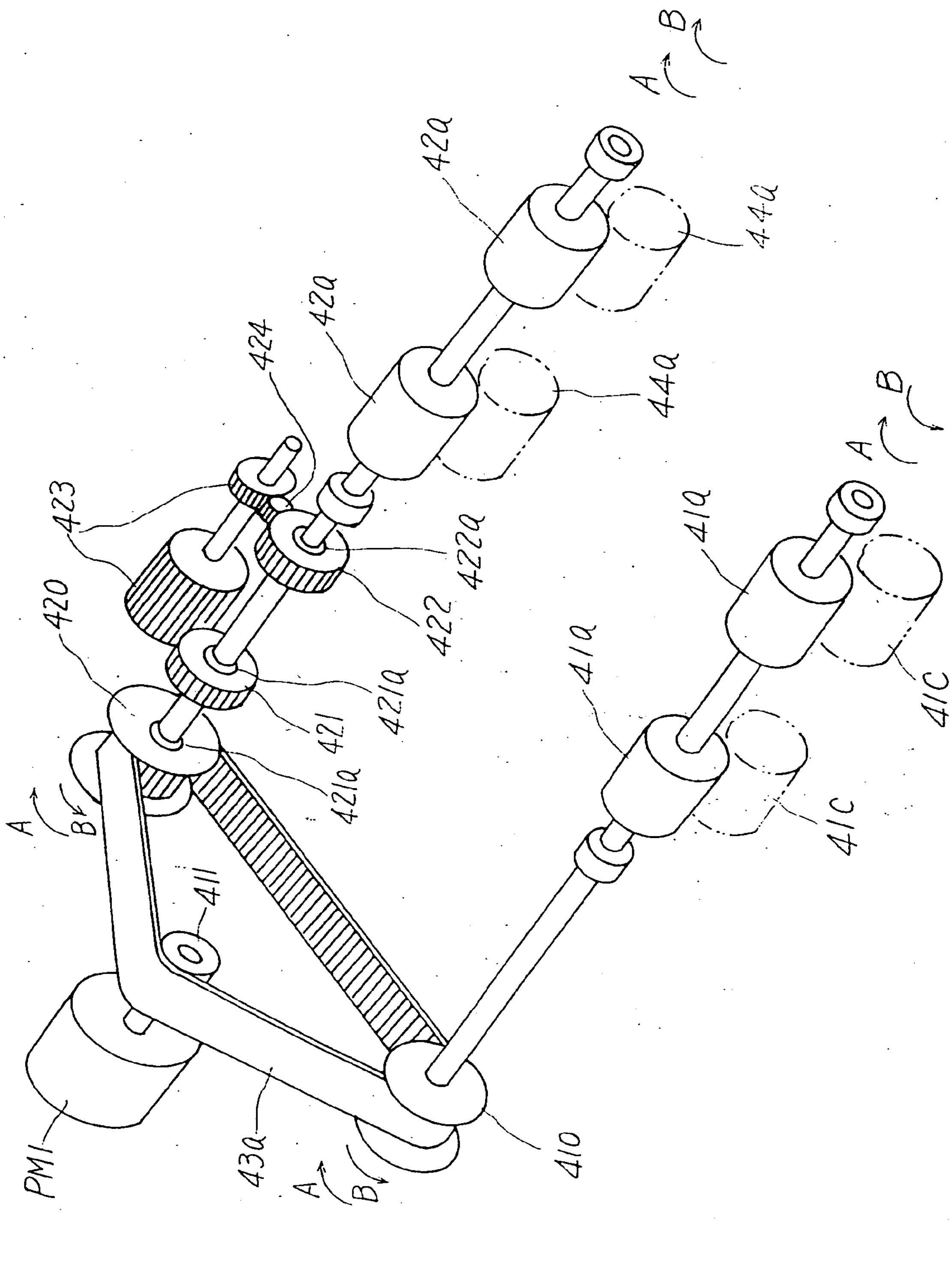

FIG. 9

BNSDOCID: <EP___0556071A2_I_>

FIG. 10

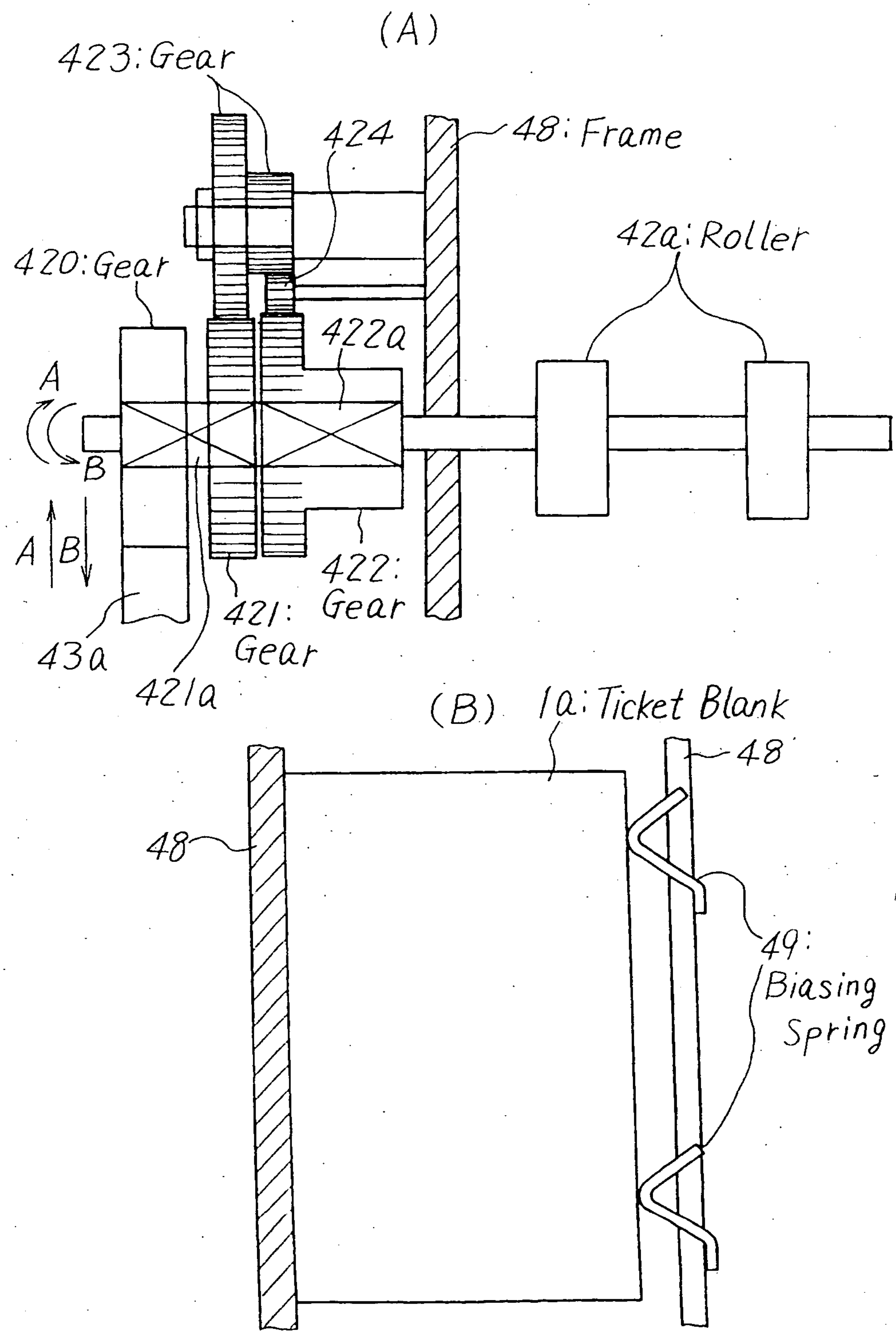

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FIG. 11

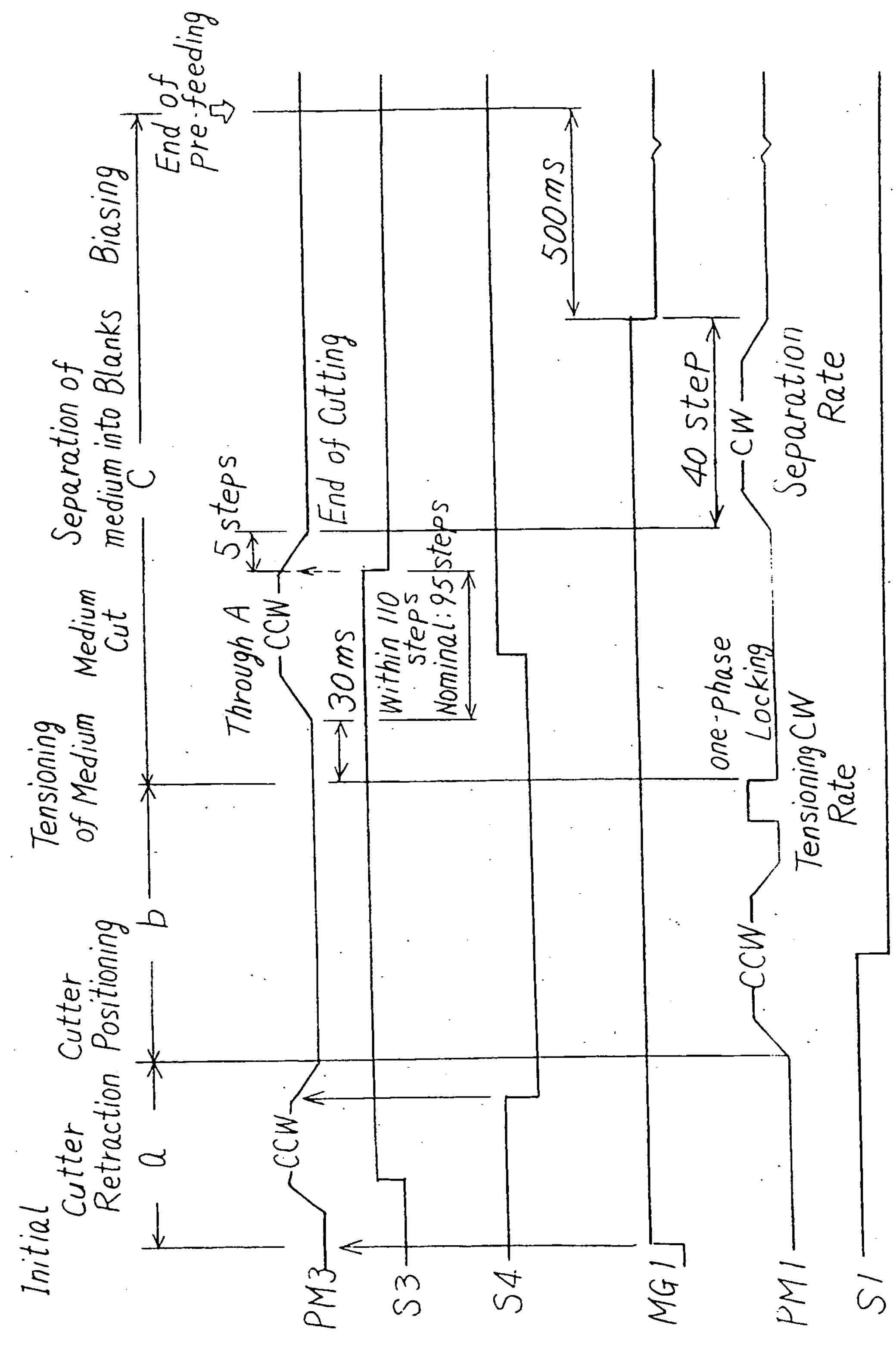

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FIG. 12

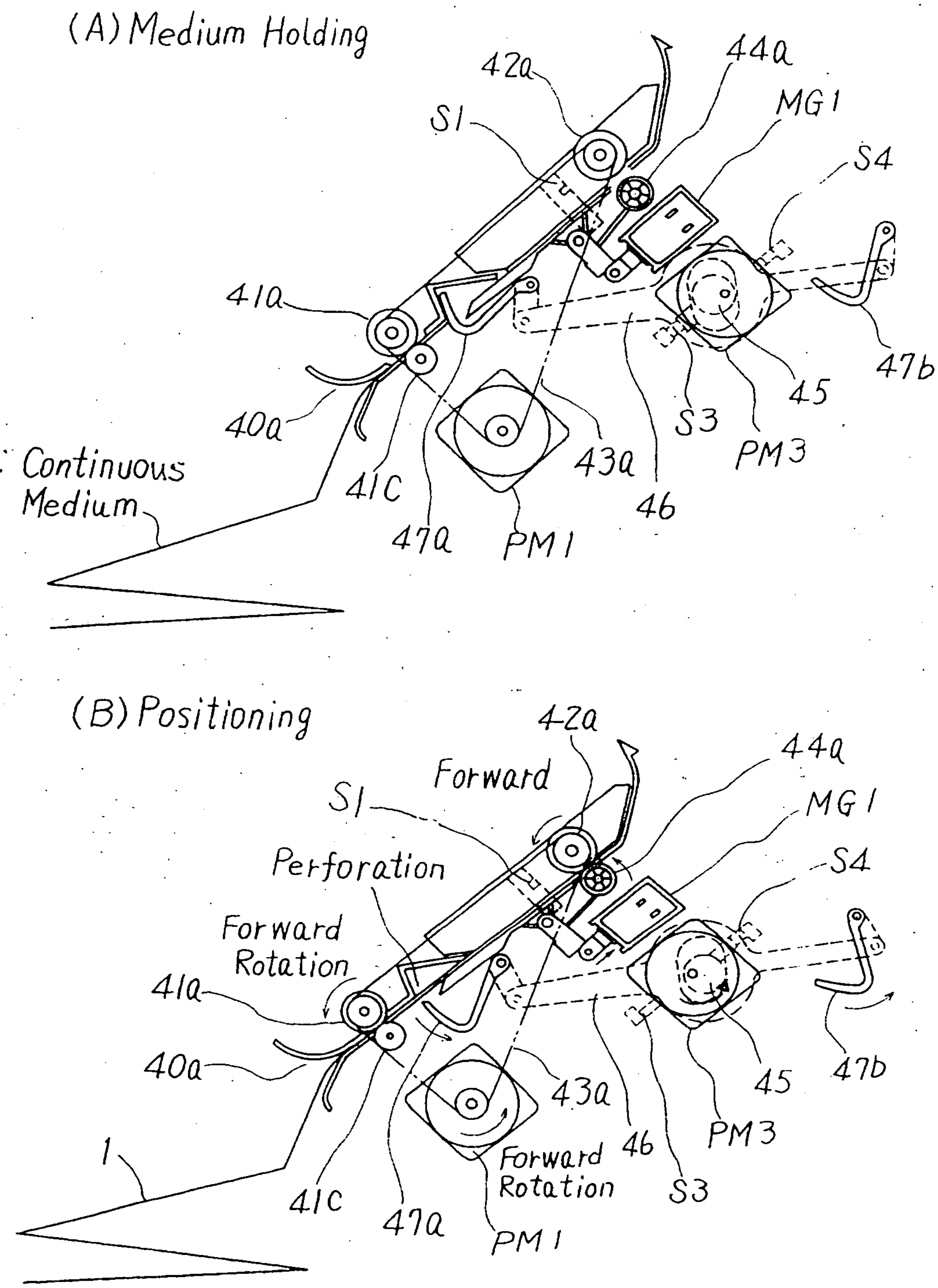

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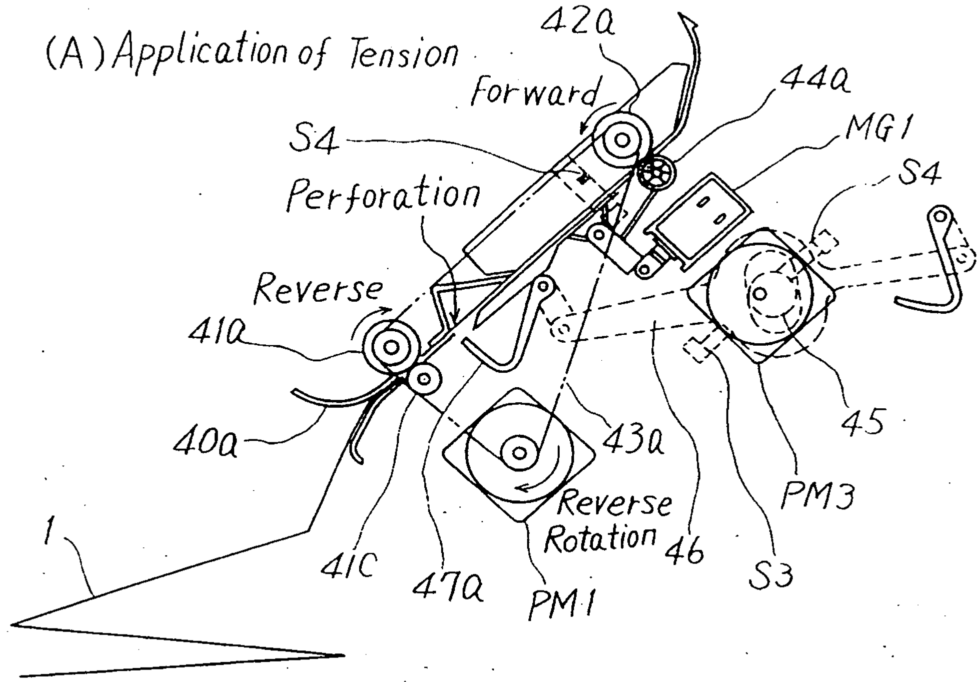
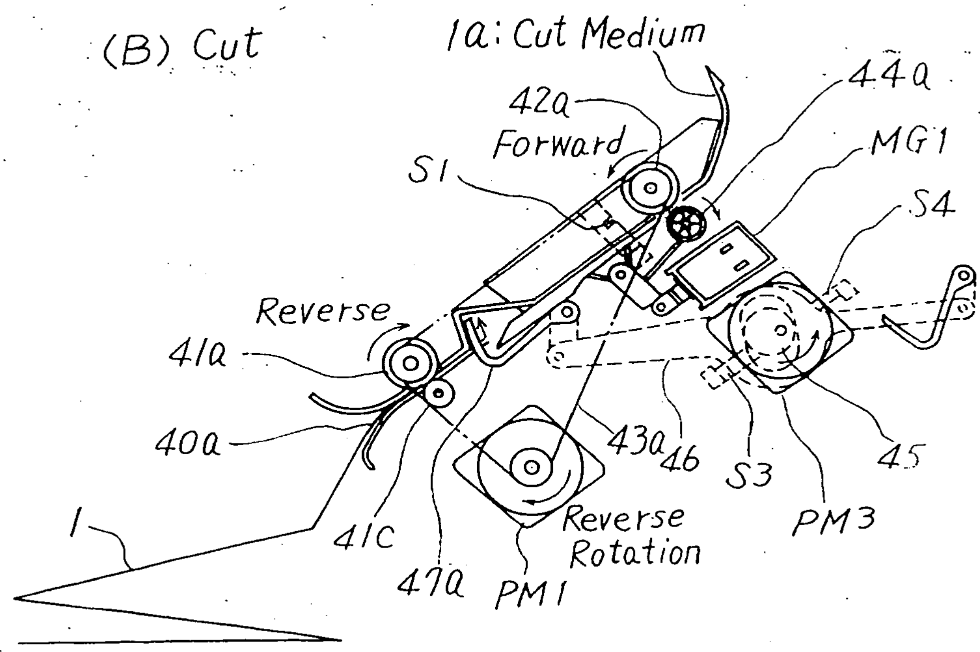
FIG. 13





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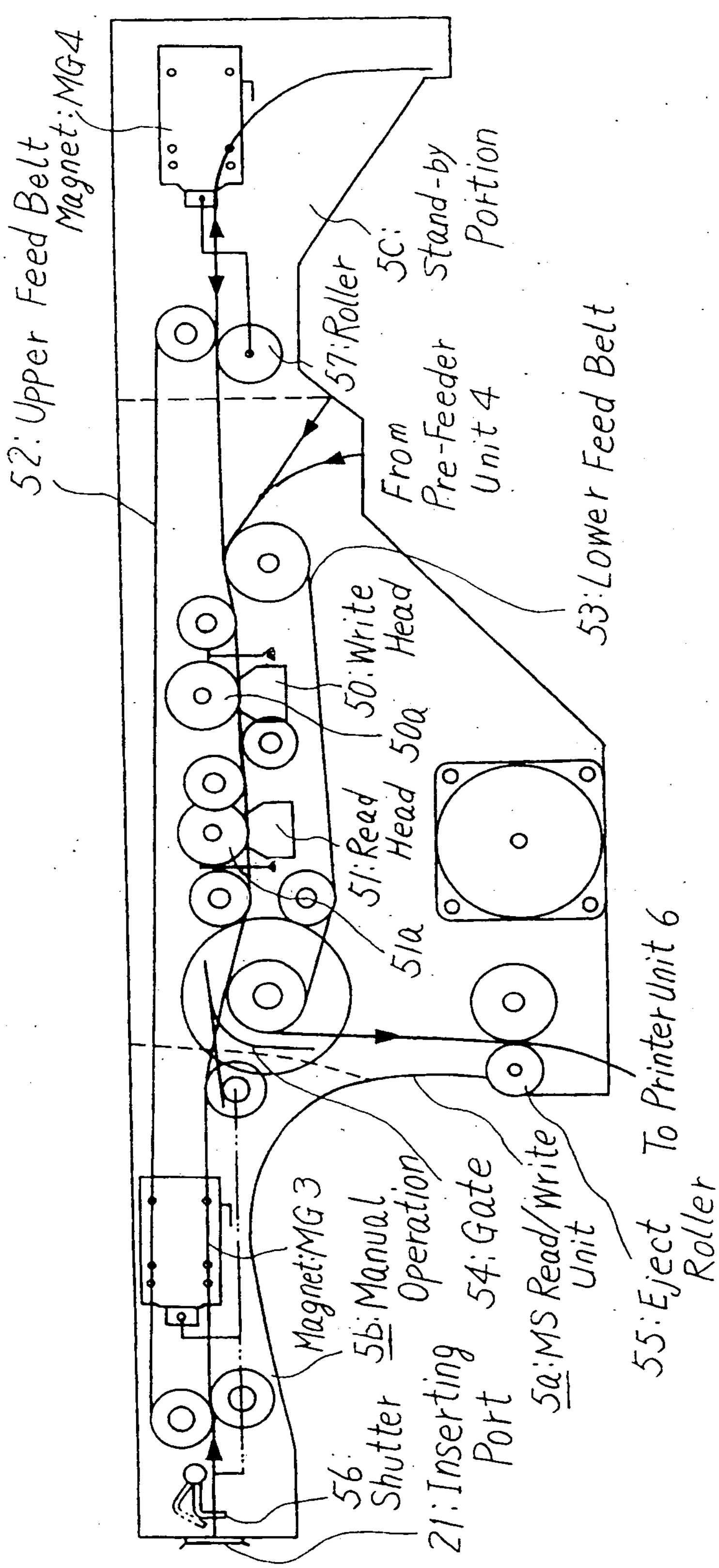

FIG. 14

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FIG. 15

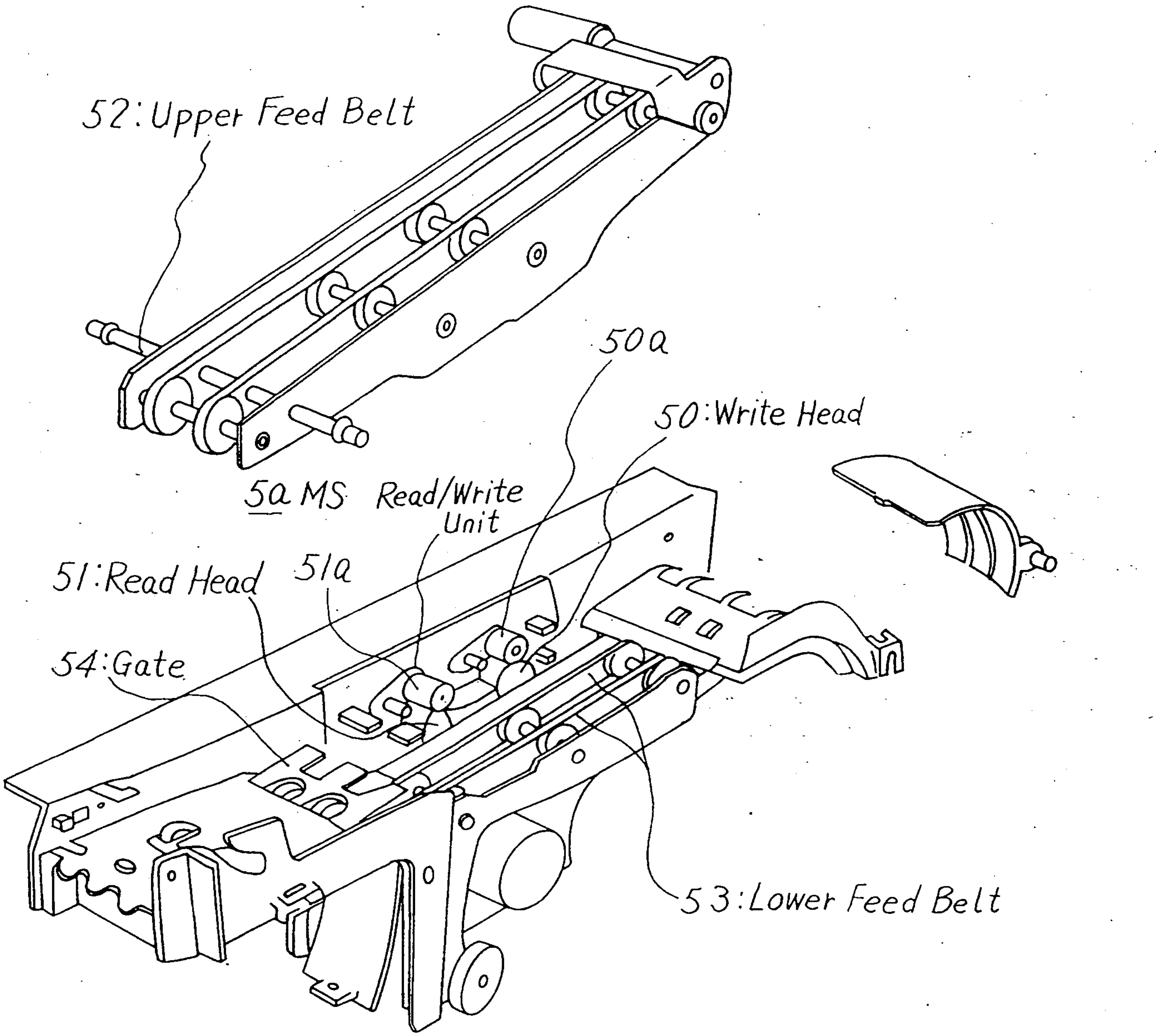

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FIG. 16

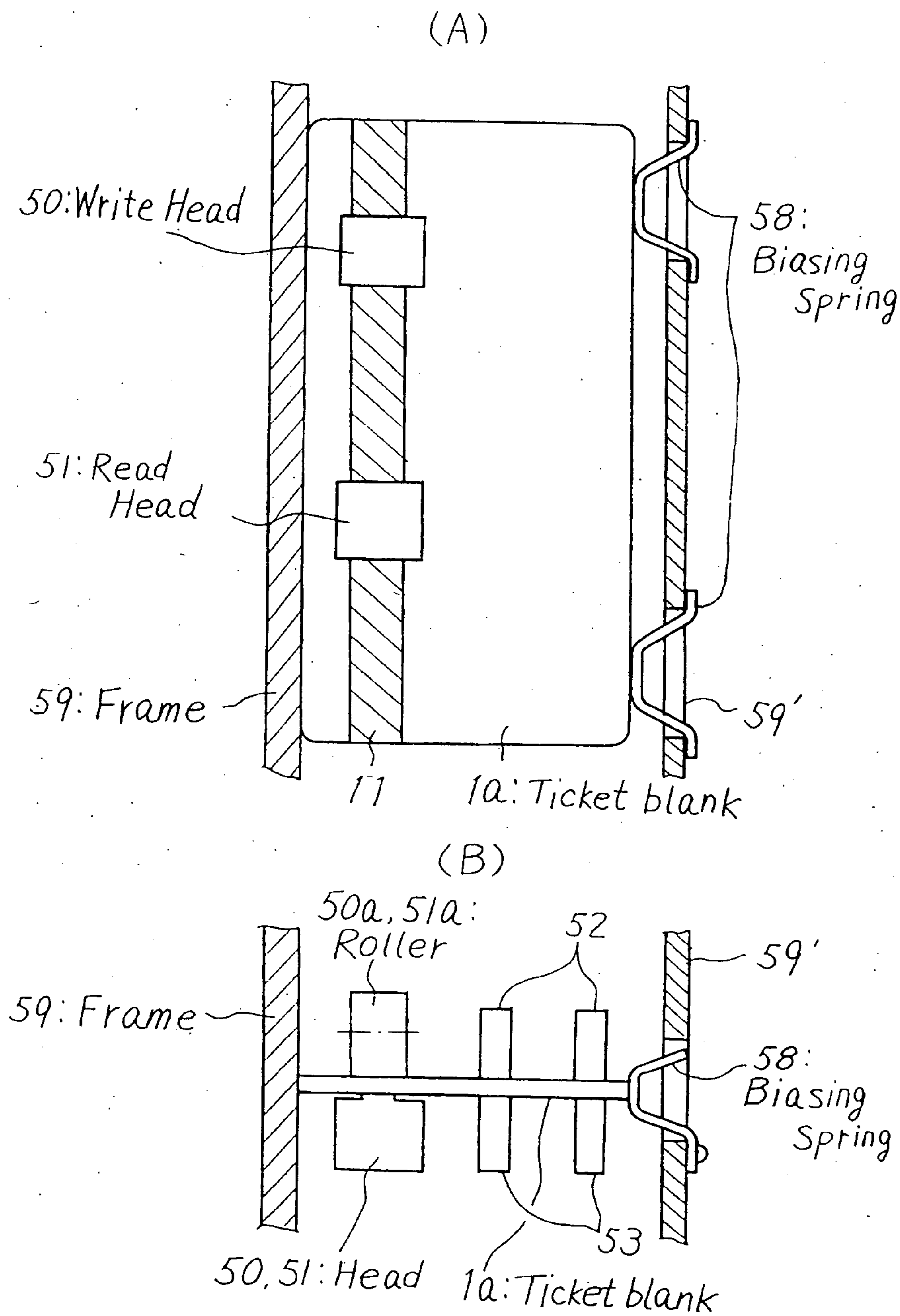

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FIG. 17

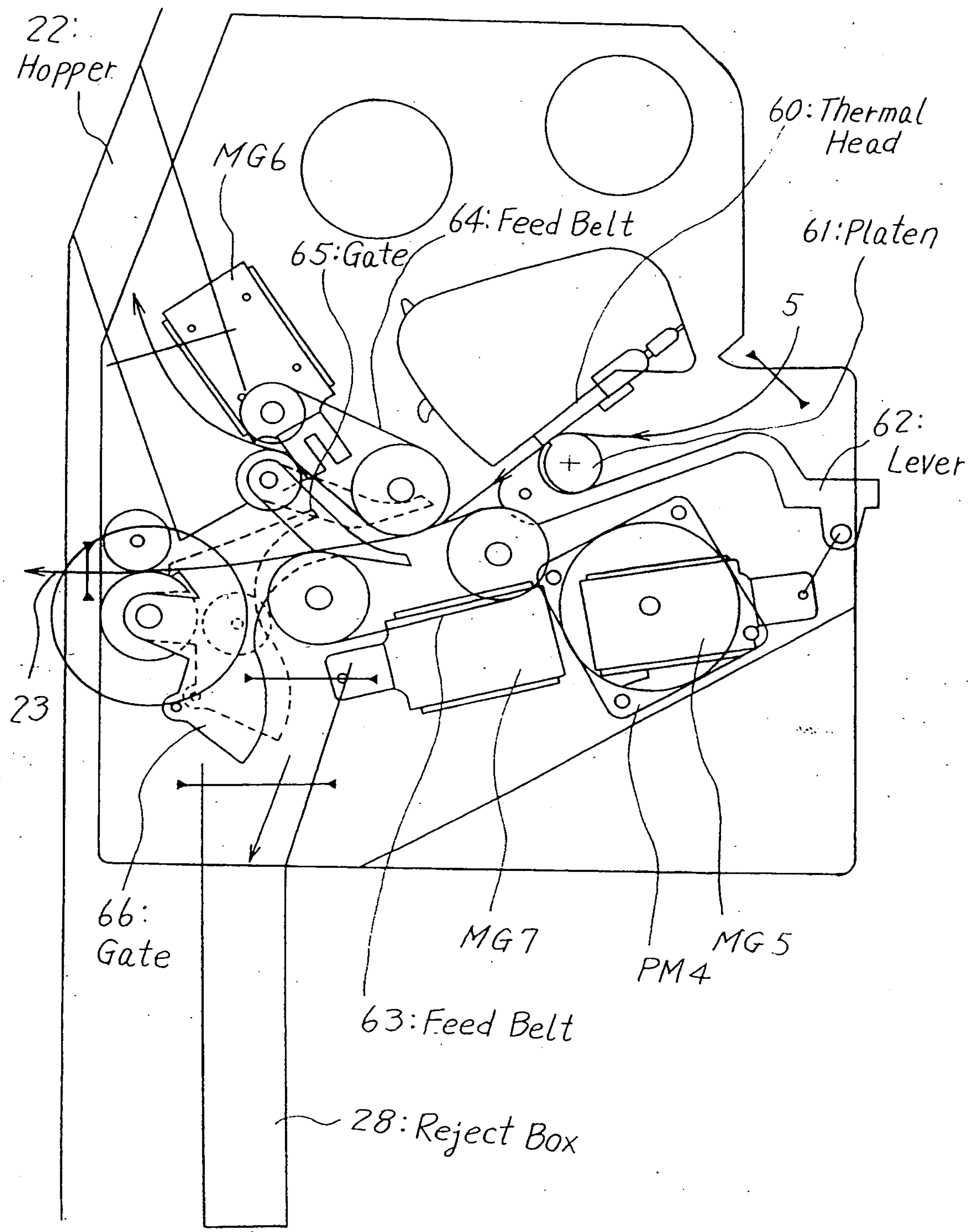

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FIG. 18

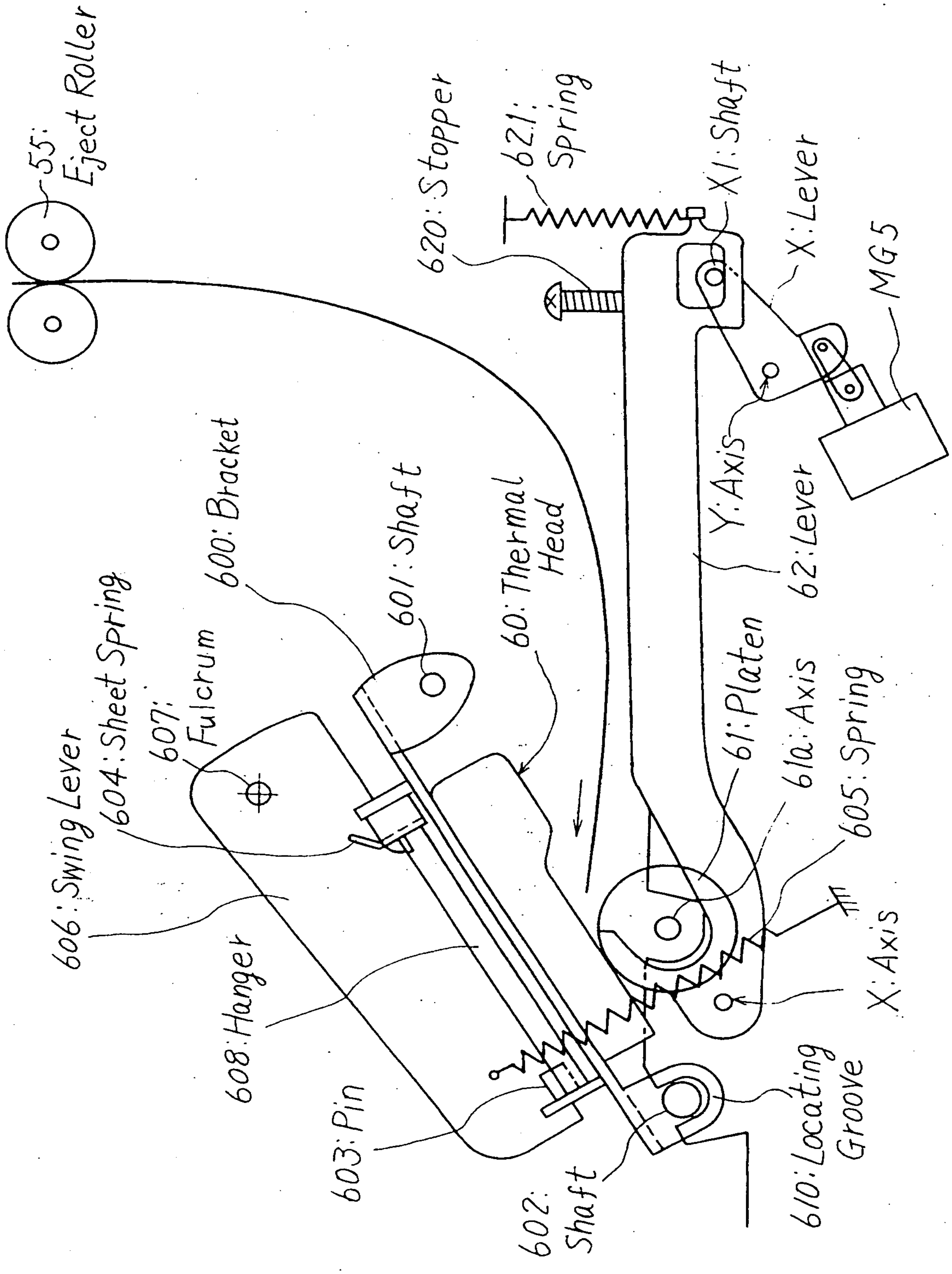

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FIG. 19

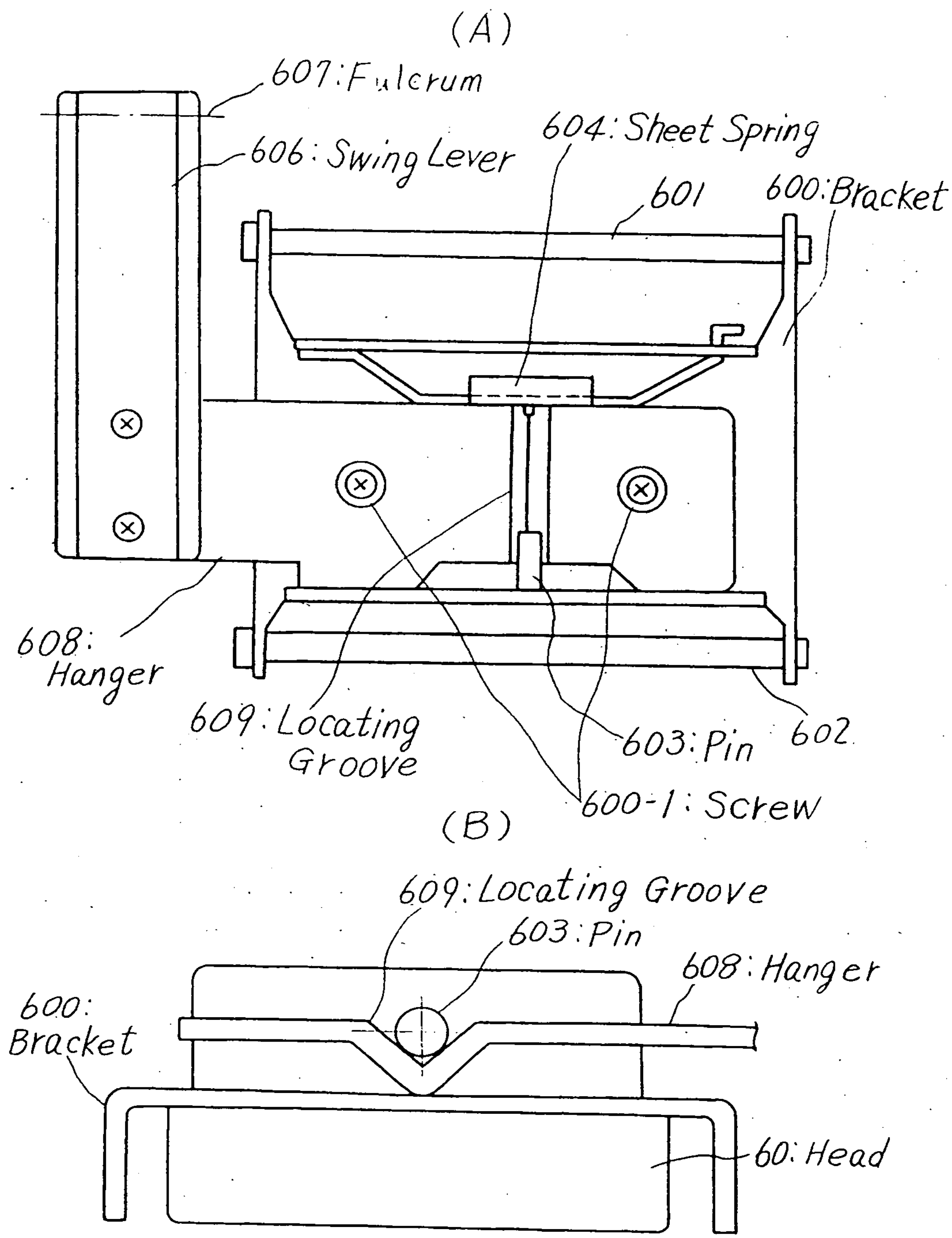

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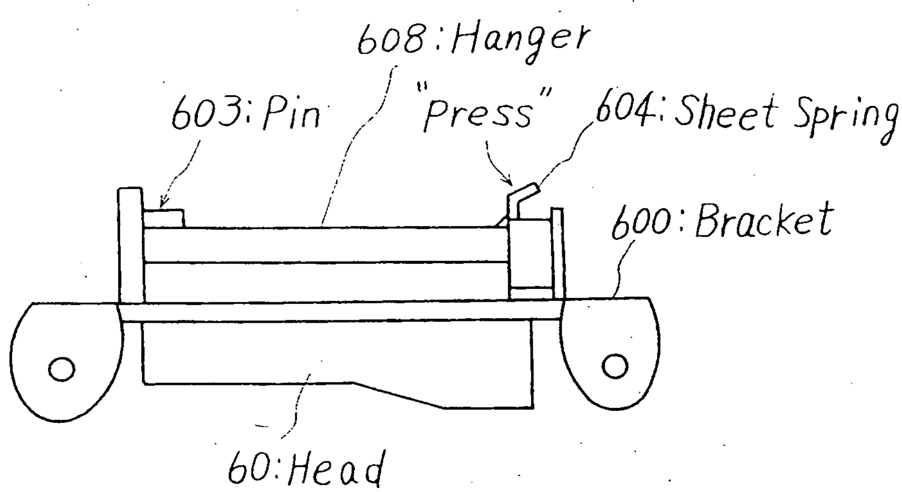
FIG. 20

(A)



(B)

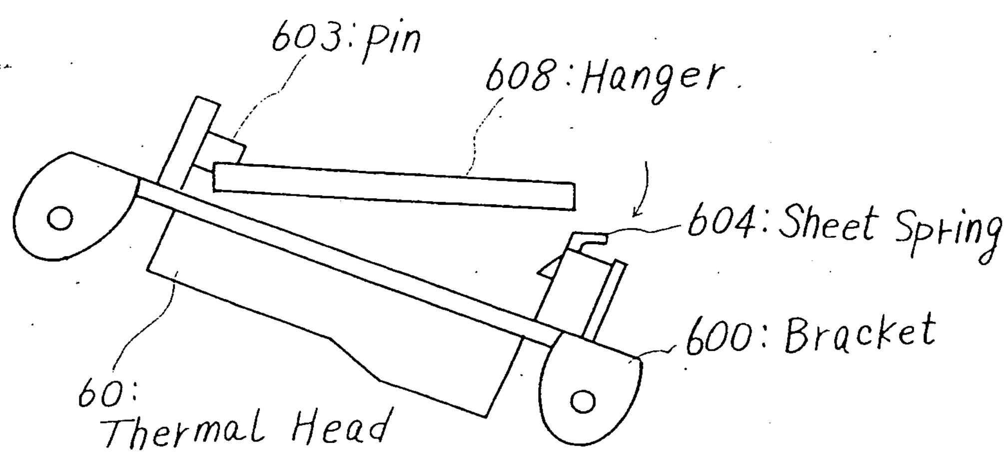


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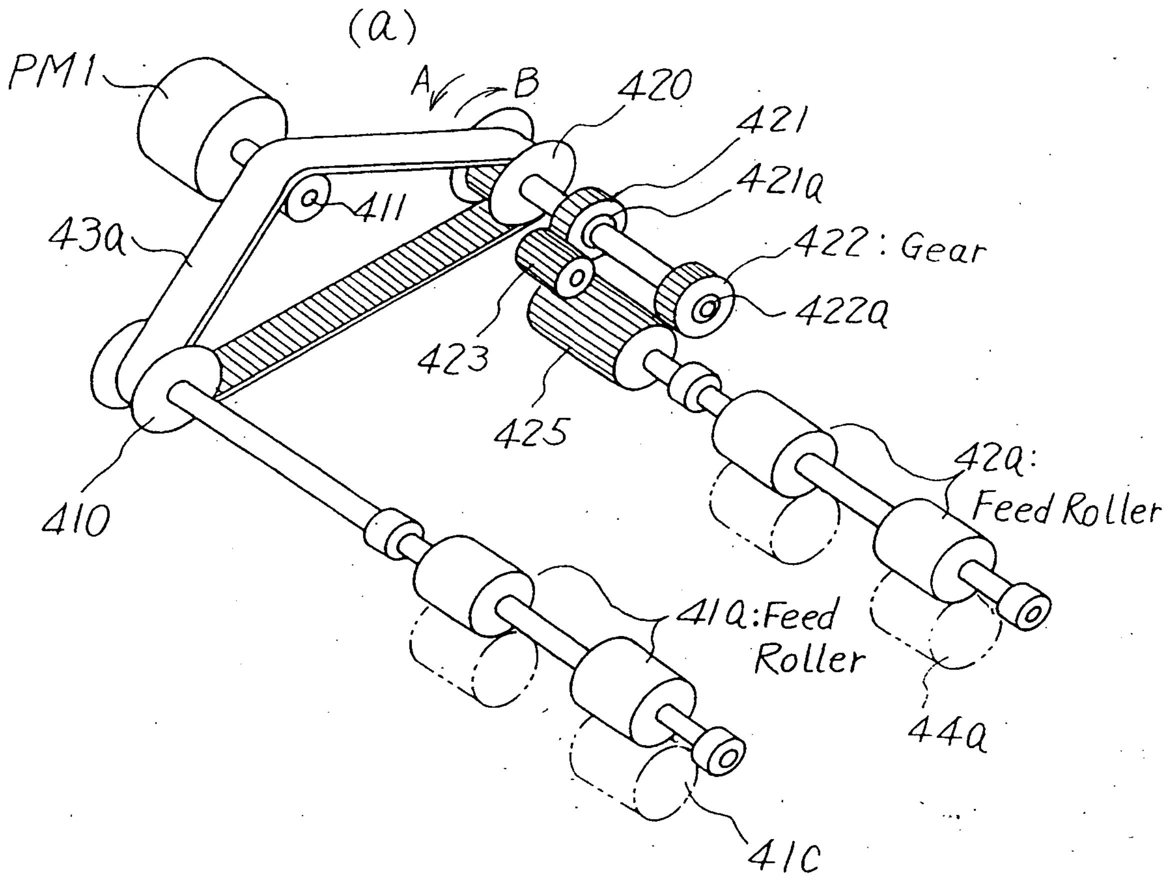
FIG. 21



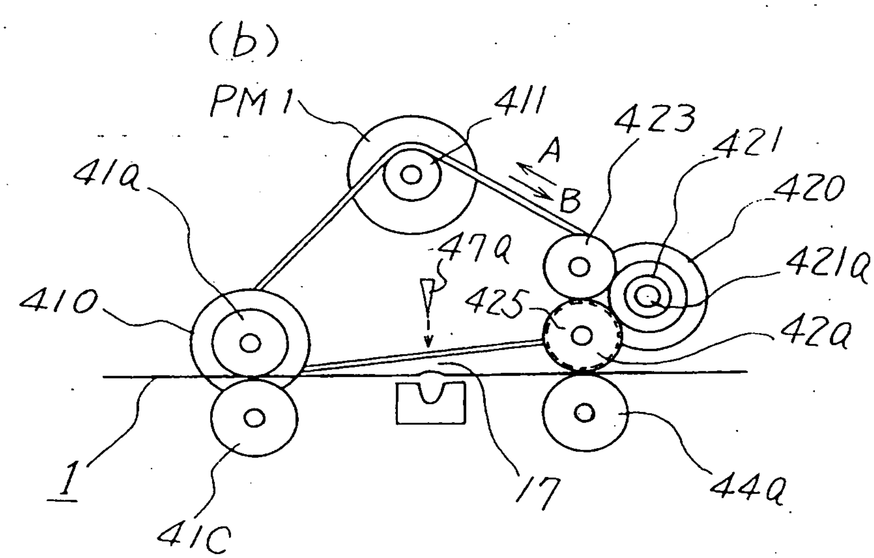


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FIG. 22

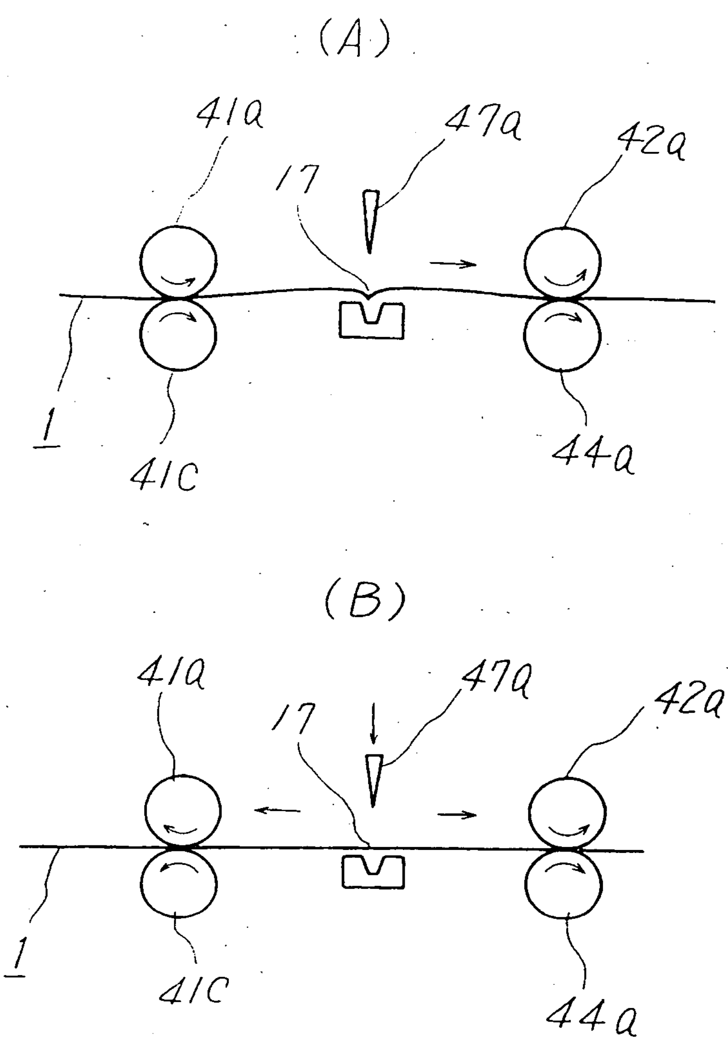

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FIG. 23

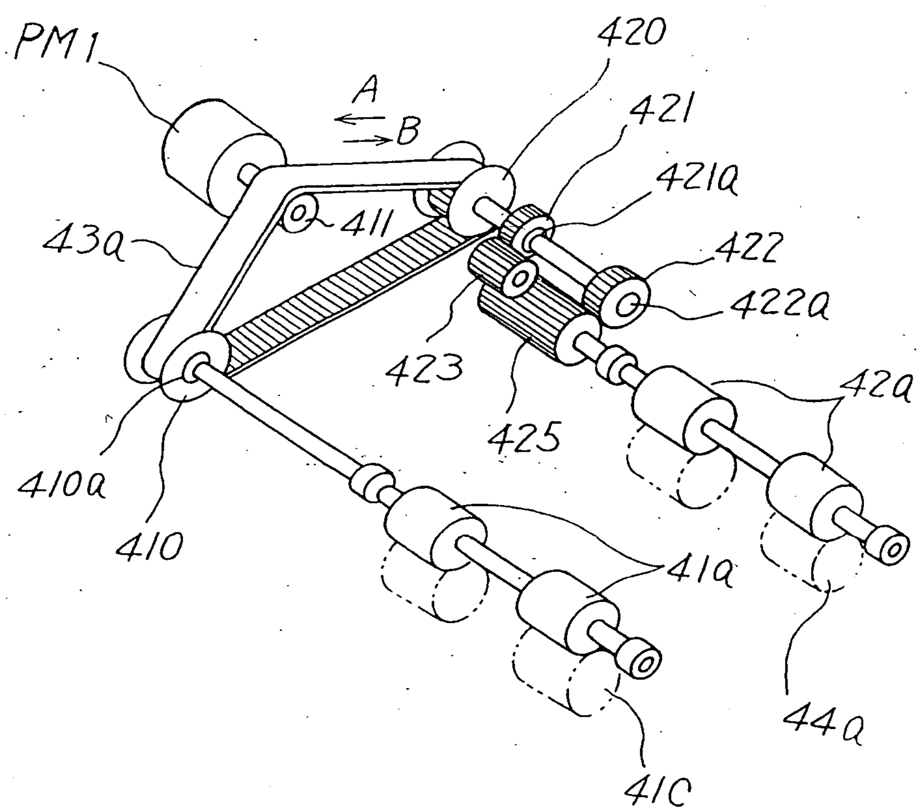

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FIG. 24

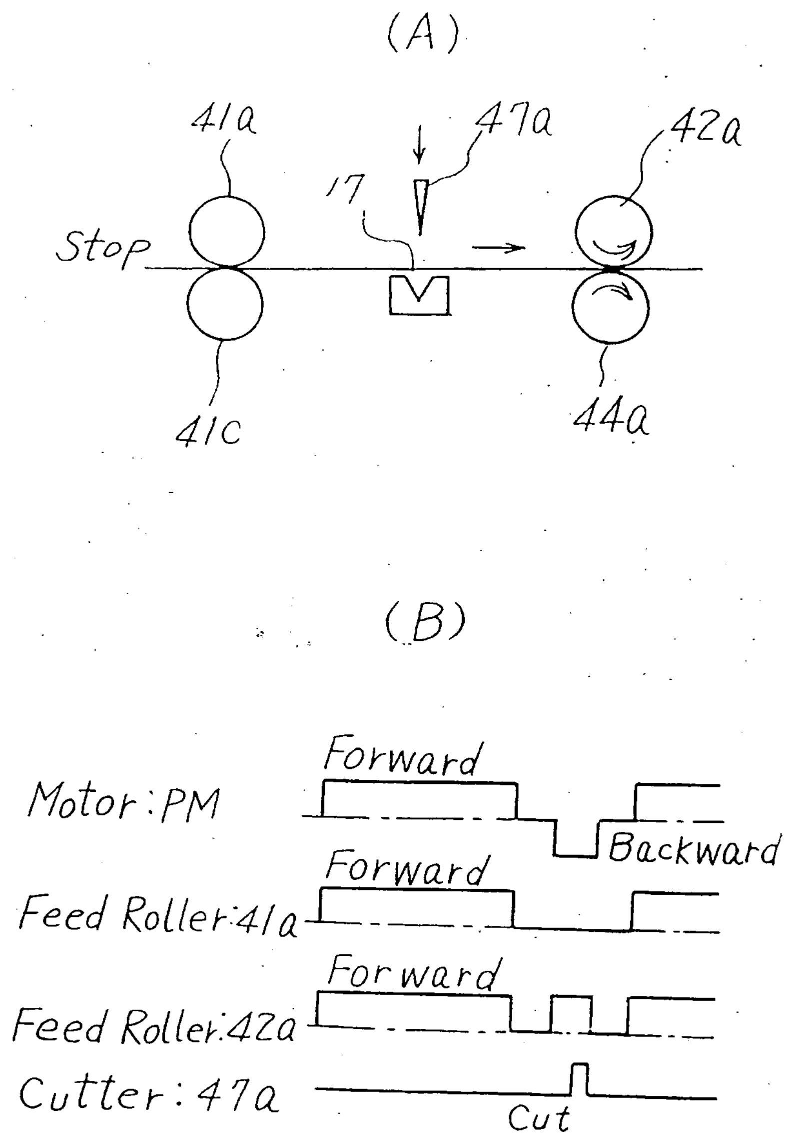

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FIG. 25

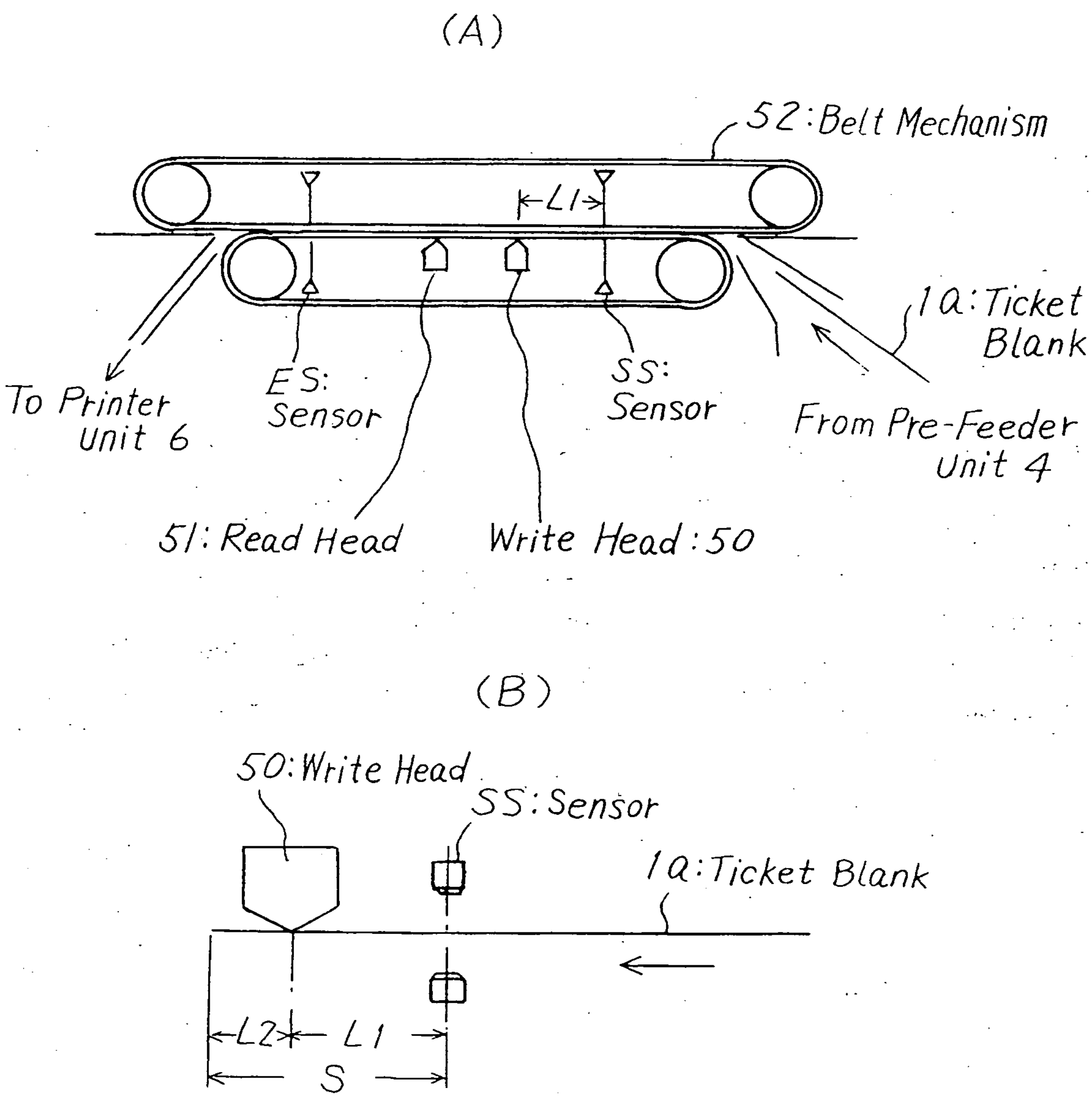

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FIG. 26

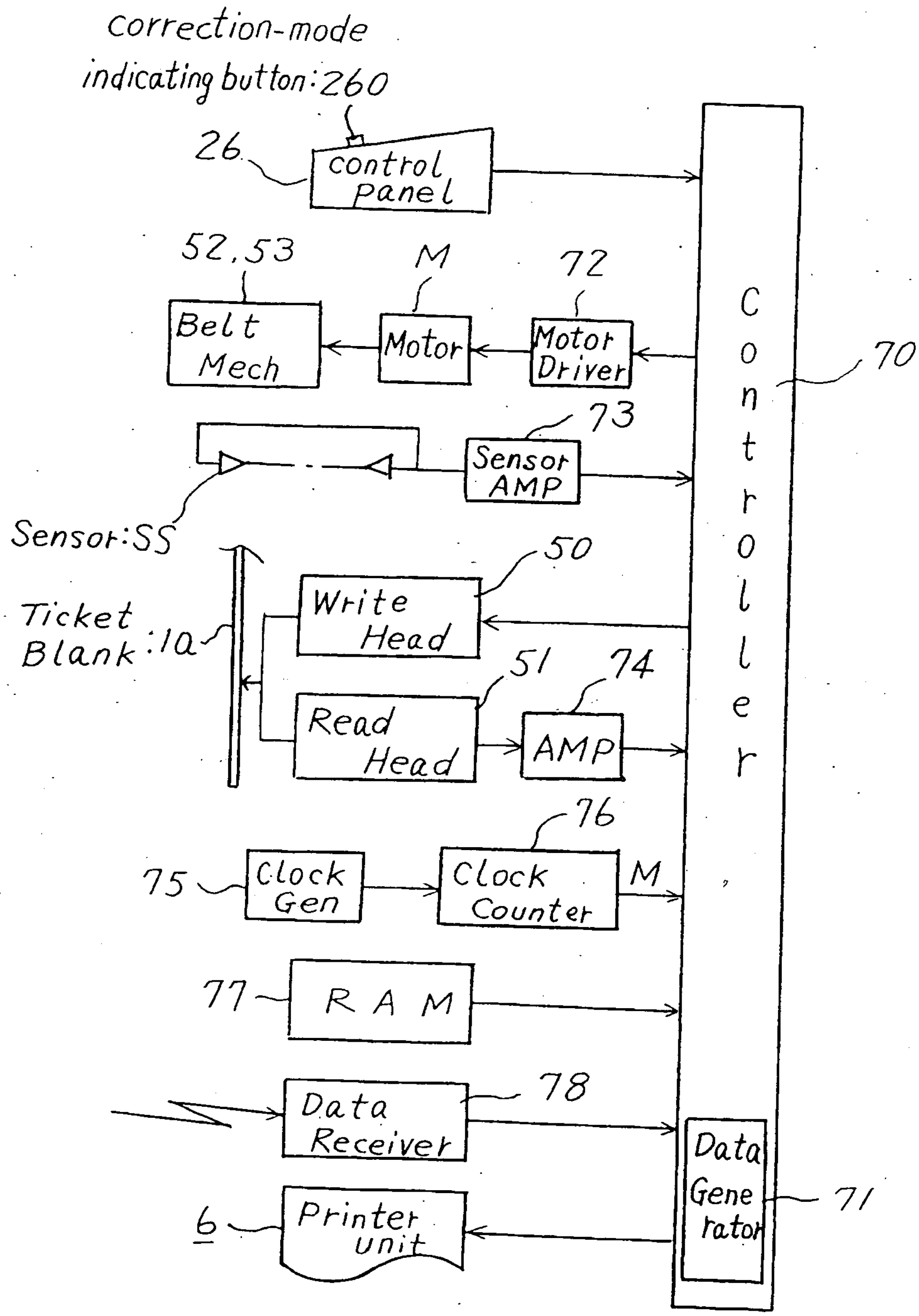

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FIG. 27

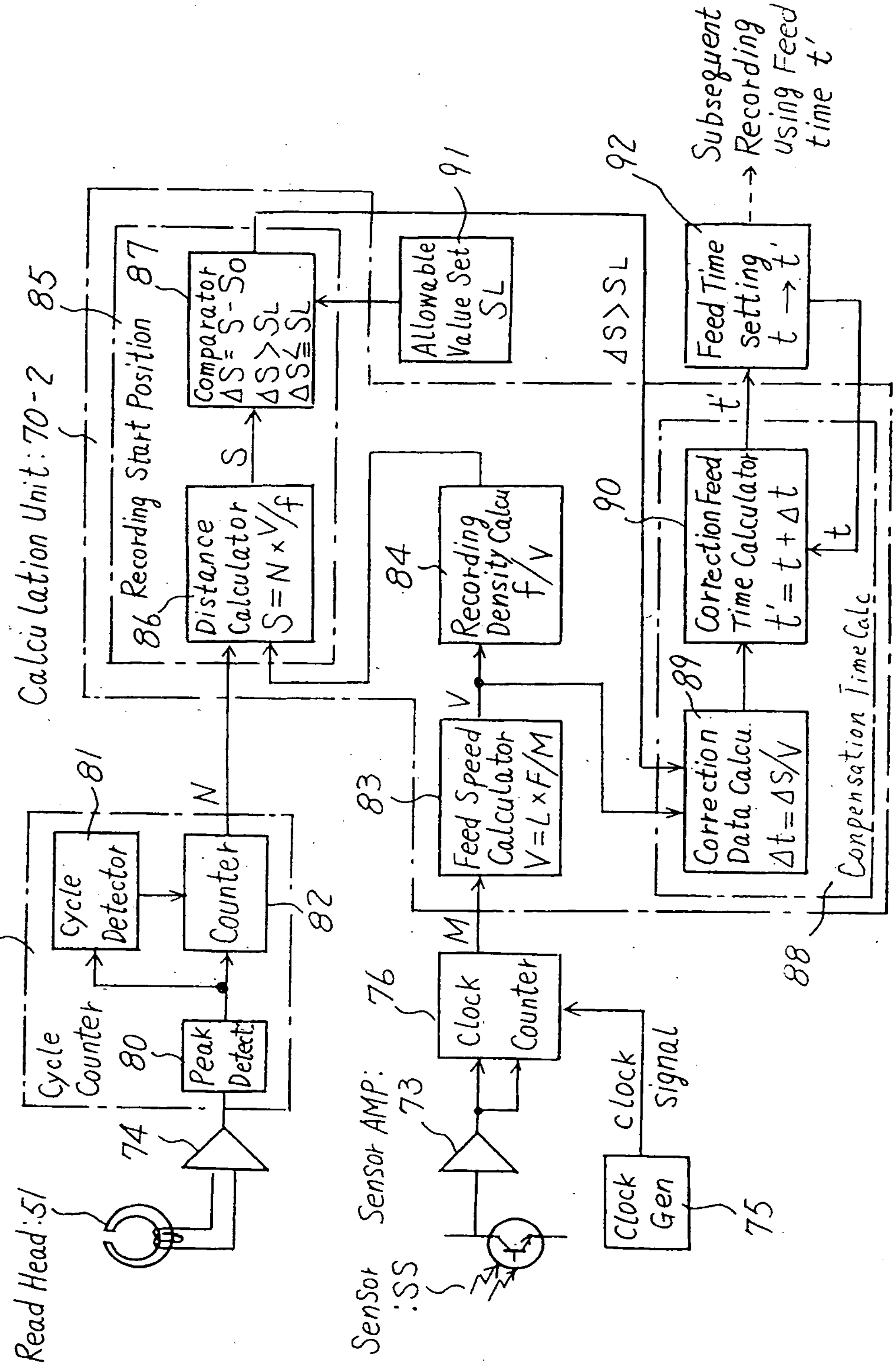

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FIG. 28

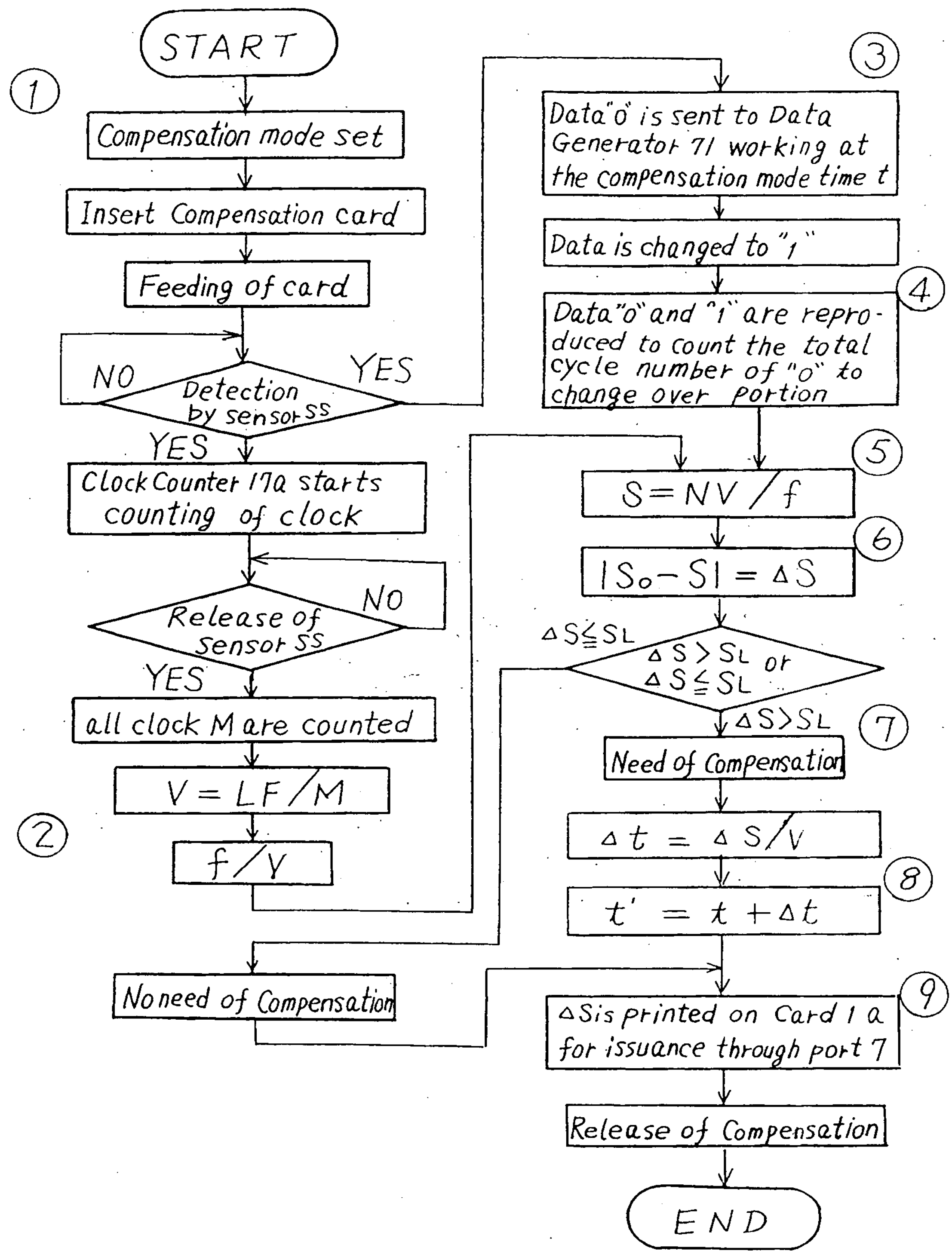

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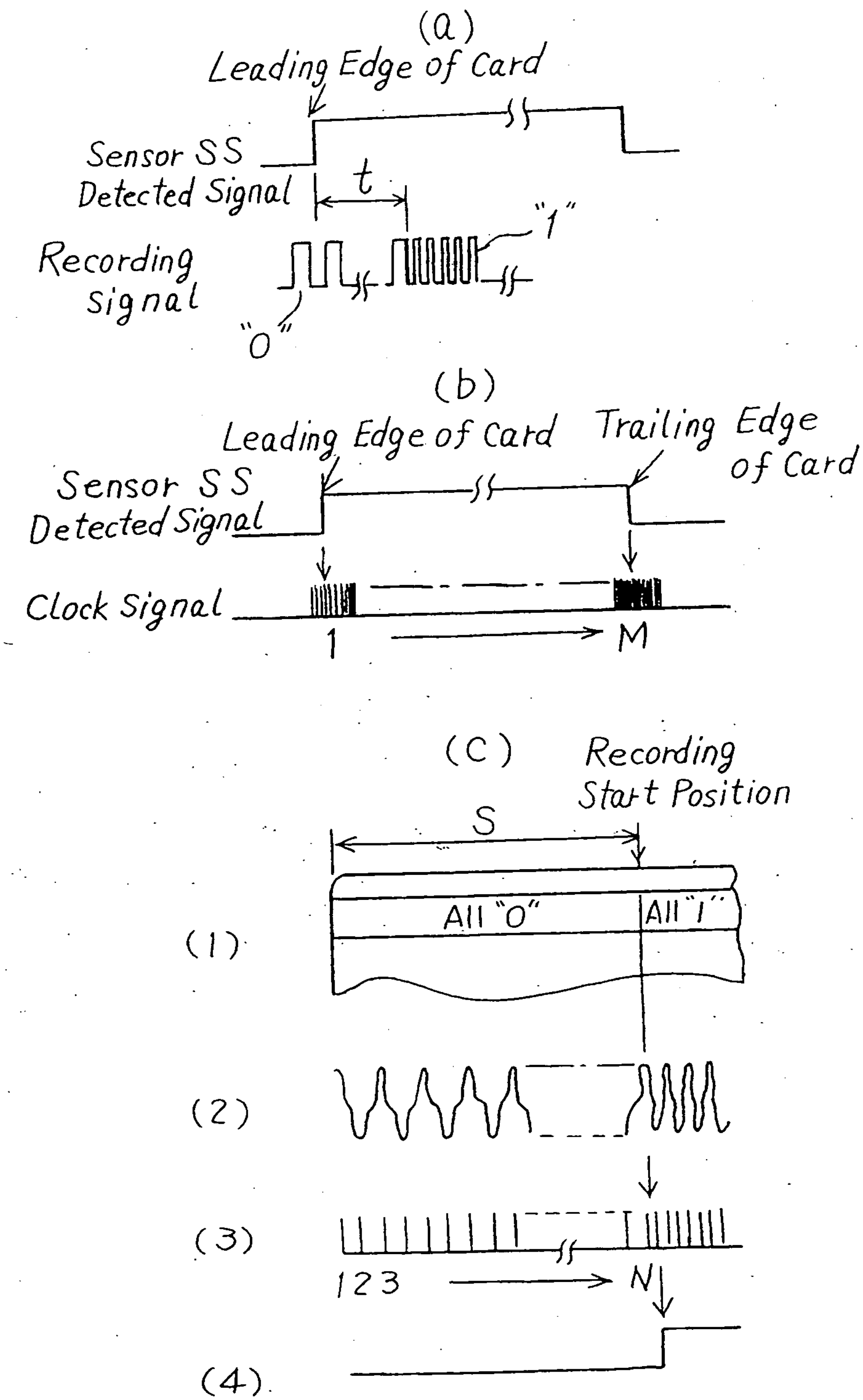
FIG. 29



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